

# LETTERS

## TOBACCO SALES TO MINORS: HAS FAMILIARITY BRED CONTEMPT FOR YOUTH ACCESS PROGRAMS?

Landrine and Klonoff<sup>1</sup> have revealed a major flaw in the way we measure underage tobacco sales. In most “compliance checks,” a supervised youngster visits a store and tries to buy cigarettes. The weighted proportion of sales in a random sample of stores estimates the violation rate for an area. The known problem with this method is that compliance checks are unreliable. Results vary with the minor’s age and appearance,<sup>2</sup> presentation (or not) of valid identification,<sup>3</sup> honesty,<sup>4</sup> and other elements. Thus, even when compliance checks produce single-digit violation rates, adolescent tobacco use often fails to decline.<sup>5</sup> The disconnect is certainly an artifact of underestimation of underage sales, but null findings have fueled doubt that anything practical can be done about youth access to cigarettes.<sup>6</sup>

Some attention has shifted to kids giving kids cigarettes,<sup>7</sup> and some advocates have intensified<sup>8</sup> longstanding calls<sup>9</sup> to abandon youth access interventions altogether. However, retail purchase remains the usual way that addicted adolescents get their cigarettes<sup>10</sup>—as well as the cigarettes they give experimenting peers headed for addiction.

Abandonment of youth access interventions would only expand the social-source problem, which may prove as hard to control as retail underage sales have been.

US regulations require tobacco-sales compliance checks, and results are reviewed before states can be funded for substance abuse prevention and treatment. The rules have withstood previous findings that compliance checks are unreliable, but Landrine and Klonoff document a more fundamental problem. Currently, we send underage strangers into randomly chosen stores to attempt a single purchase each time. But in the real world, addicted adolescent smokers choose their stores nonrandomly, establish familiarity by making noncigarette purchases, then return repeatedly as regular cigarette customers. Put simply, we simply aren’t measuring youths’ access to retail cigarettes.

However, Landrine and Klonoff may have illustrated a better method. Adolescents in tobacco control programs could establish familiarity at retail tobacco outlets across their communities, then conduct compliance checks with penalties for violators. Clerks already warn one another when “stings” are under way—maybe they would spread the word that familiarity with young customers doesn’t provide safety when selling cigarettes. A feasibility study of this strategy is being developed. If it proves effective and practical, it might really reduce youth access to cigarettes. Only then will we be able to determine whether and to what extent adolescent smoking depends on underage retail tobacco sales. ■

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**ERRATUM**

In: Biener L, Albers AB. Young Adults: Vulnerable New Targets of Tobacco Marketing. *Am J Public Health*. 2004;94:326–330.

Two tables were printed with less-than-or-equal-to signs reversed in the stub heads. In **TABLE 1—Characteristics of Sample of Adults, by Age: Massachusetts, 1995–2000**, page 327, under the heading “Education level,” the correct row is:

	Age Group, y		P
	18–30 (n = 3482)	31–65 (n = 8967)	
Education level			
≤ High school	31.6	32.3	.698

Note. ns are unweighted; proportions are weighted. Probability listed is for the  $\chi^2$  statistic.

In **TABLE 2—Smoking Characteristics Among Smokers, by Age and Race/Ethnicity: Massachusetts, 1995–2000**, page 328, under the heading “Smoking characteristics, %,” the correct row is:

	Total			Non-Hispanic White			Non-White		
	18–30 y (n = 944)	31–65 y (n = 2135)	P	18–30 y (n = 691)	31–65 y (n = 1745)	P	18–30 y (n = 244) <sup>a</sup>	31–65 y (n = 316)	P
Smoking characteristics, %									
≤ 30 minutes to first cigarette	37.7	52.8	...	39.3	52.9	...	30.2	55.4	...

Note. ns are unweighted; proportions are weighted. Probability listed is for the  $\chi^2$  statistic.

<sup>a</sup>Main effect for race/ethnicity controlled for age ( $P < .001$ ).

## EDITOR'S CHOICE



# Oral Health Care for the Elderly: More Than Just Dentures

As a dentist and a recent immigrant to the United States, I find the policy debates around health care access, quality, and financing refreshingly open. We have done a tremendous job in preventing oral diseases, exemplified by water fluoridation being heralded by the Centers for Disease Control and Prevention as one of the nation's 10 great public health achievements of the 20th century—but that we have failed, as a society, to provide quality and accessible dental care for our elderly is shortsighted at best, heartbreaking at worst.

Perhaps our antipathy to providing such care stems from pre-fluoride era realities when adults routinely lost all or most of their teeth by midlife. Although the majority of seniors today have retained most of their teeth, there are grave disparities in oral disease burden, access to oral health care, and oral health–related quality of life by race/ethnicity, social class, and medical and functional comorbidities. Partly because of improved tooth retention and partly because access to care is problematic, we are witnessing increased rates of dental diseases in seniors. This situation is likely to get worse as both absolute numbers and the proportion of older adults in the United States increase over the next several decades (see the lead editorial by guest editor Ira Lamster).

The treatment, management, and prevention of oral diseases in seniors will improve not only the conditions of their mouths, but also their overall health and well-being. Recent data indicate that periodontal diseases are associated with chronic diseases such as cardiovascular disease, cerebrovascular diseases, and diabetes. In addition, oral cancer—which is primarily seen in adults older than 60 years—can be physically, emotionally, and economically devastating. The sobering projections on the “graying of America” notwithstanding, the most compelling reason to im-

prove the oral health and health care of our seniors is apparent when a human face, complete with mouth, is affixed to the problem. Oral diseases and dysfunction can be extremely painful, and they have an acute impact on quality of life, affecting chewing, eating, speaking, and social interactions. In no segment of society are these domains of health more critical than in the elderly, for it is in this population that deficits in quality of life are most devastating.

Despite the economic challenges facing the nation, there are concrete steps we can take to improve oral health and oral health care for our seniors. First, the financing and provision of oral health care must be integrated with the mechanisms used to ensure overall health and well-being for the elderly. Second, because seniors are more likely to visit a physician than a dentist, it is imperative that primary care providers and geriatricians be educated about the medical, functional, emotional, and social consequences of oral diseases and dysfunction and that they provide regular screening and preventive education for dental diseases.

Third, the daily caretakers of homebound and institutionalized elderly—nurses, home care workers, and nurses' aides—need improved oral health care education and training. Fourth, quality assurance measures used by organizations that provide care for seniors ought to address oral health and function. Finally, the dental community must recognize that the management of oral diseases in the elderly poses specific challenges; it is vital that we generate new options for providing improved oral health care to seniors, including making geriatric dentistry a recognized specialty of dentistry. ■

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# Oral Health Care Services for Older Adults: A Looming Crisis

Two important oral health policy concerns in the United States are disparities in the oral disease burden and the inability of certain segments of the population to access oral health care.<sup>1</sup> Both of these challenges are largely due to socioeconomic stratification in US society. As a consequence of the release of the surgeon general's report on oral health,<sup>1</sup> there has been a call to action to improve the oral health of underprivileged groups who have difficulty accessing dental services. In particular, an emphasis has been placed on children, and specifically the oral health of economically disadvantaged children.

### GROWING AND DIVERSE OLDER POPULATION

In contrast to the extensive national attention focused on children's oral health in recent years, America's growing elderly population has received relatively little attention and almost no public health or public policy interventions. Population projections for the United States indicate that the elderly will constitute an increasing percentage of the population as we proceed into the 21st century.<sup>2</sup> In 2001, the population of the United States was almost 278 million, and 12.6% of the population was 65 years of age or older. By 2015, the population is expected to increase to 312 million, and 14.7% of the population will be aged 65 years or older. In 2030, which is within the practice lives of students currently enrolled in dental schools, the population will have

increased to more than 350 million, and 20% of the population—1 of every 5 members of US society—will be 65 years of age or older. Further, the elderly population will become increasingly diverse in terms of race/ethnicity, financial resources, and living conditions.

A substantial number of older adults will be able to function quite independently in their communities. The majority of their working lives will have been spent during periods of relative economic prosperity. With attention to oral health earlier in their lives, these seniors will have complete or near-complete dentition and sufficient resources to afford some out-of-pocket expenses for dental services. In contrast to these community-dwelling elders, others will be homebound or have limited access outside their homes, while still others will live in long-term care (LTC) facilities. Access to dentists will be just one of many difficulties that will complicate attempts to provide health care to this group of seniors.

For the vast majority of seniors in LTC facilities, financing of oral health care services will be a formidable challenge. Medicare does not provide coverage for routine dental services, and in the absence of private insurance or personal resources, a large portion of this group will not be able to afford any dental services whatsoever, let alone the most appropriate treatments. Clearly, there must be a response to the increasing oral health concerns of the elderly who present with special needs, especially those

who are homebound or living in LTC facilities and burdened with other chronic disorders.

### DISPROPORTIONATE IMPACT OF ORAL DISEASES ON SENIORS

For both obvious and less obvious reasons, oral and dental diseases have a disproportionate effect on the elderly. In addition to years of exposure of the teeth and related structures to microbial assault, their oral cavities will show evidence of wear and tear as a result of normal use (chewing and talking) and destructive oral habits such as bruxism (habitual grinding of the teeth). The elderly also suffer from chronic disorders that can directly or indirectly affect oral health, including autoimmune disorders such as pemphigus and pemphigoid.<sup>3</sup> The elderly often require multiple medications, and a common side effect of more than 500 medications is reduced salivary flow.<sup>4</sup> A reduction in saliva can adversely affect quality of life, reduce the efficiency of chewing, and lead to significant problems of the teeth and their supporting structures.

The elderly may also have difficulty performing routine oral hygiene procedures because of physical limitations. In addition, oral infection is now recognized as a risk factor for a number of systemic diseases, including cardiovascular and cerebrovascular diseases, diabetes mellitus, and respiratory disorders. Finally, it is important to emphasize that once people have become edentulous (toothless) and are using com-

plete dentures, their oral health needs do not cease. Jaws are not static and may continue to resorb over time. Ill-fitting prostheses can adversely affect chewing and lead to poor nutrition. People without teeth remain susceptible to oral cancer, mucosal diseases, and alterations in salivary gland function.

## SENTINEL MEASURES OF ORAL HEALTH

Tooth loss is one general measure of oral health status of a population. While there are many diseases that affect the oral cavity, caries (cavities), periodontal disease (gum disease), and oral and pharyngeal cancer are other sentinel measures used to track oral health at the population level.

### Tooth Loss

The percentage of individuals who are totally edentulous has decreased from the time period 1971–1974 (National Health and Nutrition Examination Survey [NHANES] I) to the time period 1988–1994 (NHANES III).<sup>1</sup> This was found across all age groups: 18 to 34 years (from 2.0% to 0.44%), 35 to 54 years (from 12.6% to 5.2%), 55 to 64 years (from 33.3% to 20.1%), and 65 to 74 years (from 45.6% to 28.6%). However, this encouraging trend is accompanied by other challenges. As the aging population retains more teeth, these seniors will be at increased risk for caries and periodontal diseases.

Furthermore, there are distinct regional and state differences in tooth loss experienced by older Americans (those older than 65 years).<sup>5</sup> According to data from the Behavioral Risk Factor Surveillance System

(BRFSS), the highest percentages of edentulous individuals were seen in Kentucky (42.3%) and West Virginia (41.9%), while the lowest percentages were observed in Hawaii (13.1%) and California (13.3%). Determinants of loss of 6 or more teeth include lack of a high school diploma, a household income of less than \$15 000, self-identification as non-Hispanic Black, current smoking, and being in poor to fair health status (including having diabetes).

### Dental Caries

Dental caries constitute the most common disease of childhood. Nevertheless, as adults retain all or more of their teeth into their later years, the number of teeth at risk for root caries, as opposed to the coronal caries commonly observed in children, will increase. In fact, in the most recent national survey (NHANES III), nearly half of all individuals aged 75 years or older had root caries on 1 or more teeth. A comparison of NHANES I and NHANES III—for which data were collected in 1971–1974 and 1988–1994, respectively—reveals that the percentage of teeth with caries (treated or untreated) decreased for individuals between the ages 18 and 54 years but increased for those between the ages of 55 and 74 years.<sup>1</sup> The progression of root caries in an individual with little or no saliva can be quite rapid, and the restoration of these lesions is often technically challenging.

### Periodontal Diseases

Periodontal diseases constitute the second most common group of oral disorders. These are inflammatory disorders affecting the supporting structures of the

teeth; they manifest as tissue inflammation and loss of alveolar bone supporting the teeth. NHANES III clearly demonstrated that the proportion of adults with loss of attachment along the root surface (a measure of periodontitis) increased with increasing age. For example, the percentage of individuals who displayed at least one tooth with at least 4 mm of loss of attachment increased from 3% for persons aged 18 to 24 years to 12% for those aged 25 to 34 years, 22% for those aged 35 to 44 years, 55% for those aged 65 to 74 years, and 65% for individuals aged 75 years or older.<sup>1</sup>

As noted previously, the concern for increased prevalence of periodontitis in older individuals must be considered in light of the risk posed by periodontitis for certain systemic disorders, including cardiovascular and cerebrovascular diseases, diabetes mellitus, and respiratory disorders. Periodontal infections are chronic, and the gram-negative bacteria that characterize advanced forms of periodontitis can be an important source of endotoxins. These organisms, and endotoxins, gain access to the systemic circulation, with resultant activation of the inflammatory response. Patients with periodontitis have been shown to be at increased risk for myocardial infarction, fatal myocardial infarction, and stroke.<sup>6,7</sup> Anti-infective treatment of periodontitis has been shown to improve the metabolic management of poorly controlled diabetes mellitus,<sup>8</sup> and a professionally administered oral hygiene program provided to LTC patients has been shown to reduce the occurrence of fever and death due to pneumonia.<sup>9</sup>

### Oral and Pharyngeal Cancer

Each year, approximately 30 000 individuals in the United States develop oral cancer. Oral and pharyngeal cancers are predominantly disorders of the elderly; the median age at diagnosis is 64 years. Epidemiological surveys reveal that the incidence of these disorders decreased approximately 0.5% per year over the period from 1973 to 1996. However, one disturbing statistic is that the survival rate for these cancers has not improved in 25 years.<sup>1</sup> The etiology of oral and pharyngeal cancers has been intensely studied, and cigarette and alcohol use are the primary determinants. Hence, smoking cessation activities are increasingly recognized as vital to dental practice.

## ADDRESSING THE ORAL HEALTH CARE NEEDS OF THE ELDERLY

The need for a coordinated effort to address the oral health care needs of the elderly is suggested by demographic trends and epidemiological data. Such a plan must consider contributions from the dental profession, possibly through the efforts of the American Dental Association (ADA) and its state and local associations; the dental schools, with involvement of the American Dental Education Association; federal, state, and local health authorities; and assistance from national organizations and foundations that focus on health care. With adequate attention and focus, a variety of national initiatives with implementation on the state and local levels will serve to improve access to oral care for older Americans who are currently most in

need, including the poor and disabled.

While effective preventive measures exist for younger populations (water fluoridation, dental sealants), no preventive measures are yet available to address the expected increase in oral health needs of the aging population. There are, however, a number of approaches that should be considered.

Geriatric dentistry should receive increased emphasis in the nation's dental schools, specifically in predoctoral dental curricula. This suggestion has been proposed in the past, but it assumes new urgency at this time. Nevertheless, it is important to recognize that there is a need to balance the ever increasing demands for curricular time with the requirement that dental schools graduate individuals who are capable of treating the public after only 4 years of education.

A national program for older Americans similar to the ADA-sponsored "Give Kids a Smile" should be launched. In addition, a campaign comparable to the ADA-supported initiative to increase awareness about oral cancer may prove effective. Mandatory continuing education in geriatric dentistry is another approach to informing the practice community about the oral health care needs of the elderly. According to the ADA, at least 45 states and the District of Columbia and Puerto Rico require continuing education for relicensure of dentists (data on file, ADA, Department of State Government Affairs, October 22, 2002). Data from recent BRFSS surveillance activities<sup>5</sup> indicate differences in tooth loss by geographic locale, supporting the concept of regional or state strategies.

US dental schools, which often focus their service programs on those who have difficulty accessing care, can focus both on-site and off-site care activities on older populations. This could be accomplished via local outreach to older, fully ambulatory seniors, who could come to the school clinics for care, and by seeking collaborations with nursing homes and other LTC facilities for older adults with greater health and personal needs. Many of these facilities have on-site dental care, but staffing may be limited owing to budget constraints.

Effective and relatively inexpensive preventive procedures and protocols can be employed for the elderly who have problems accessing care, including application of topical fluoride varnishes and anti-infective (chlorhexidine) rinses or swabs. Under certain circumstances, these services could be delivered by home health aides or staff at LTC facilities.

Collaboration with other health care providers who routinely treat the elderly should be encouraged, with a focus on increasing their awareness of potential oral health problems. They might be asked to discuss the need for dental care visits and proper dental care with their patients. A cursory oral examination can be conducted by health care professionals other than dentists, who can then make referrals on the basis of their findings or specific patient complaints.

The challenges faced by both the dental profession and the nation as a whole regarding provision of oral health care services to older adults were the subject of a recent report prepared by Oral Health America.<sup>10</sup> This report notes that older Americans suffer disproportionately from

oral diseases, and the problem is particularly acute for individuals in LTC facilities. Further, all 50 states were surveyed to determine the level of Medicaid coverage for dental services, and the report concludes that financing oral health care services for the elderly is a major challenge. Medicare does not provide any coverage for dental services, and only 1 of 5 Americans aged 75 years or older has any type of private dental insurance. The overall assessment for the nation, reflecting availability of dental coverage, is a grade of D.

The ADA report *The Future of Dentistry* briefly addressed the problem of financing of dental services for the elderly, especially in light of reductions in employer-sponsored coverage of dental services for retired workers.<sup>11</sup> While suggestions were offered (tax-deferred accounts for medical and dental services, reliance on public funding for special-needs and disabled individuals), a comprehensive plan was not proposed.

## A CALL FOR NATIONAL ATTENTION TO GERIATRIC DENTISTRY

On September 22, 2003, the Senate Special Committee on Aging held a forum chaired by Senator John Breaux of Louisiana on "Ageism in Health Care: Are Our Nation's Seniors Receiving Proper Oral Health Care?" The surgeon general, representatives of the ADA and the American Dental Education Association, and practitioners involved in the provision of care to the aged, blind, and disabled, were passionate in their concern for the crisis at hand.

It is generally acknowledged that there is a paucity of dental

practitioners who are formally trained to meet the needs of elderly patients. Geriatric dentistry is not a recognized dental specialty. There is no obvious source of support for training a new group of "gerodontologists." Since care of the elderly is not the specific purview of any dental subspecialty, professional organization-based responses to the challenge of providing oral health care services to the elderly need to be developed. The dental profession has an opportunity to take a leadership role in the delivery of health care services to the seniors who have contributed so vitally to our society's well-being and who deserve to be treated with the best oral health care we have to offer. ■

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# Strengthening the Oral Health Safety Net: Delivery Models That Improve Access to Oral Health Care for Uninsured and Underserved Populations

The mission of the W.K. Kellogg Foundation's Community Voices initiative is to improve access to primary, behavioral, and oral health care for uninsured and underserved populations. Poor access to dental services and growing racial/ethnic disparities in oral health demand new interventions and models of delivery.<sup>1</sup> Oral health is a core component of all 13 Community Voices "learning laboratories." Three of these programs—Northern Manhattan's Community DentCare, New Mexico's Health Commons, and North Carolina's FirstHealth—provide innovative partnership models that seek to address some of our nation's most pressing oral health care needs.

## NORTHERN MANHATTAN: COMMUNITY DENTCARE MODEL

Poor oral health was identified as the number one health complaint in a 1992–1994 population-based survey of Central Harlem adults.<sup>2</sup> In response, the Columbia University School of Dental and Oral Surgery, working in partnership with community-based organizations, devised and implemented the Community DentCare Network.<sup>3</sup> Three linked community-based dental programs provide oral health care access to residents of Northern Manhattan across the life span, from children in the Head Start program to the elderly. The

Community DentCare delivery system provides preventive and comprehensive treatment from fixed and mobile facilities, regardless of patients' ability to pay for services. The 3 major components of the Community DentCare Network are 7 public middle school–based dental programs; 1 mobile dental clinic to reach the Head Start population during the school year and the elderly population during the summer; and 4 community health center sites offering comprehensive dental services.

Dental examinations revealed higher rates of dental caries in Northern Manhattan schoolchildren than in African American and Hispanic schoolchildren nationwide.<sup>4</sup> The Community DentCare Network recorded 50 000 patient visits last year and provided 7000 school children with critical preventive dental services (including sealants) and dental treatment. Follow-up studies are needed to determine how effective Community DentCare has been in reducing oral health disparities for Northern Manhattan residents.

## NEW MEXICO: THE "HEALTH COMMONS" MODEL

Access to oral health services in New Mexico is poor and getting worse. Nationally, New Mexico ranks 49th in dentists per capita, 50th in child pov-

erty, and 1st in the percentage of its population that is uninsured. In response to this oral health crisis, New Mexico Community Voices has been piloting and disseminating its "health commons" model.<sup>5</sup>

This community partnership model of enhanced primary care includes medical, behavioral, social, public health, and oral health services. It focuses on improving access to and quality of care for New Mexico's underserved populations. Many of the intractable health problems in New Mexico's communities are the consequences of historic, social, and economic factors. Such issues cannot be addressed adequately by a single health provider group or even by the health sector as a whole. Better solutions emerge when different sectors of society, including government agencies, educational institutions, businesses, and public and private stakeholders, collaborate rather than compete. Integrating key health services and community resources results in improved quality, efficiency, and capacity.

The cornerstones of the health commons model are the neighborhood care sites that serve as the safety net for the uninsured and underinsured. At these centers, medical, behavioral, social, public health, and oral health services are colocated. But colocating services is only the initial step in implementing an interdis-

ciplinary, holistic approach to health care delivery. Many oral health patients have comorbidities such as diabetes and depression, in addition to social, language, and economic barriers to care. Each component of health care delivery (medical, behavioral, and dental) improves with better coordination of services and information.

In the health commons model, patient-centered oral health care is delivered by an interdisciplinary team. Depending on the client's needs, the service providers may include a primary care physician or provider, a dentist or dental hygienist, a nurse or nurse's assistant, a social worker, or a community health worker. The health commons safety net sites receive reengineering training enabling all members to function as a patient-centered, interdisciplinary team. The health commons model embraces health professions students and resident trainees as integral members of these interdisciplinary teams.

The University of New Mexico (UNM) Health Sciences Center is the state's only academic health center. It provides critical safety net services and trains future health providers. For example, 40% of the state's actively practicing physicians were trained at UNM during medical school or residency. While New Mexico lacks a dental school, UNM already trains dental hygienists and just received approval to begin a dental residency program. With support from the W.K. Kellogg Foundation's Community Voices Initiative, the UNM School of Medicine's Department of Surgery greatly expanded the capacity of the Division of Dental Services. While the institution had no dentists on the faculty at

the start of the program, it now has 8. Its capacity has grown to include a 4-chair dental clinic at UNM, a referral system for dental emergencies arriving at the emergency department, the newly approved dental residency program, and outreach dental services throughout the state. Over the past year, UNM dentists and dental hygienists have provided care to more than 23 600 adults and children at community-based health clinics, federally qualified health centers, and university-operated sites.

### THE FIRSTHEALTH MODEL

Hoke, Montgomery, and Moore counties in North Carolina have 12 000 medically underserved children without health care coverage or access to dental care. FirstHealth of the Carolinas, a private, not-for-profit health care network, strives to meet the comprehensive health care and dental needs of all residents of the mid-Carolinas. In a dental needs assessment, oral health care was cited as the number one unmet need for low-income children in the region, but only 10% of dentists participated in publicly assisted programs. Few Medicaid patients were being seen, yet dental care providers were already working at capacity. The shortage of providers was especially acute for pediatric dental services.

Accordingly, FirstHealth developed an integrated model of dental service delivery. An oral health task force was created to identify strategies to address the oral health crisis. The task force prioritized improving access for children through a public model based on a private practice setting. With support from the W.K. Kellogg Foundation and local

philanthropies, including the Duke Endowment and the Kate B. Reynolds Charitable Trust, FirstHealth opened a community-based dental care center in each of the 3 counties in the region.

Two of the 3 dental care centers use existing medical centers as their home sites, and the third operates in a newly constructed facility. These dental care centers provide comprehensive dental care for more than 7000 children, or nearly 60% of the targeted underserved population. By ensuring that all children who are eligible for insurance coverage are enrolled in Medicaid or other programs, FirstHealth proactively assists the financial sustainability of its dental care centers. In addition, children and their families can access other health benefits through the program and delivery sites.

### CRUCIAL ELEMENTS FOR STRENGTHENING THE ORAL HEALTH SAFETY NET

The common core elements of these 3 successful models are (1) involving the community in planning and implementation, (2) building upon the existing health safety net to link dental services with primary care, and (3) changing public or institutional policy to support the financing and delivery of dental care.

At all 3 sites, community support and involvement have been critical to building the political will and resources for the development of these dental programs. In each region (Northern Manhattan, New Mexico, mid-Carolinas), a committee, council, or task force was created to build consensus on the problems and potential solutions. Because they involve providers, educators, community members, and poli-

cymakers, these 3 models are community-based, linked to primary care, and integrated with needed social services. In building upon the existing infrastructure of safety net services, information and data systems, and health provider capacities (both medical and dental), each model integrates oral health into primary care services, thus improving the efficiency of both medical and dental services.

These collaborative efforts are helping to sustain the delivery of critical services while longer-term strategies are developed to improve access to oral health care and reduce oral health disparities. These longer-term strategies include surmounting the shortage of dental providers in underserved communities, increasing the diversity of the health professions workforce, and balancing the financing of health care to cover early prevention and health promotion as well as treatment of existing disease.

Improving access to oral health care and reducing disparities in oral health requires both institutional and health policy changes. Health service fragmentation creates formidable barriers. Using existing health care providers—pediatricians, family physicians, emergency room physicians, dental hygienists—where there are dental provider shortages can help strengthen the oral health safety net. While 44 million Americans have no health insurance, 100 million have no dental coverage. Most uninsured and underserved populations rely on Medicaid, yet states are cutting budgets and eliminating dental benefits. Thus, collaborative models such as those presented here may be the most cost-efficient and high-quality way to assure access to oral health services.

Coverage of dental services and adequate reimbursement rates will help improve access to care for underserved and uninsured populations.

## SCALING UP COMMUNITY-BASED DENTAL CARE MODELS

A perplexing dichotomy currently exists. *A National Call to Action to Promote Oral Health* exhorts the dental profession and community-based clinics to take action to improve access to dental care in the United States.<sup>6</sup> On the other hand, state governments—desperate to get their budget deficits under control—are cutting adult dental benefits from their Medicaid programs. Models offering basic oral health services in connection with community-based primary care services may ensure holistic, comprehensive health care for our most vulnerable and underserved populations. ■

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# What's New About the "New Public Health"?

From its origins, when public health was integral to societies' social structures, through the sanitary movement and contagion eras, when it evolved as a separate discipline, to the "new public health" era, when health promotion projects like Healthy Cities appear to be steering the discipline back to society's social structure, public health seems to have come full circle. It is this observation that has led some to ask, "What's new about the 'new public health'?"

This article addresses the question by highlighting what is new about the health promotion era—including adapted components of previous eras that have been incorporated into its core activities—and its suitability in addressing established and emerging public health threats. (*Am J Public Health*. 2004;94:705–709)

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## THIS ARTICLE CONSIDERS

6 major approaches to public health practice implemented between ancient times and the contemporary era, defined more by important milestones than by convention. These approaches are (1) public health as health protection, mediated through societies' social structures; (2) the shaping of a distinct public health discipline by the sanitary movement ("miasma control"); (3) public health as contagion control; (4) public health as preventive medicine; (5) public health as primary health care; and (6) the "new public health"—health promotion (Table 1).

The hallmark of the health protection era was enforced regulation of human behavior in order to protect the health of the individual and the community. Such enforced regulation was usually mediated by ruling elites through society's religious, political, cultural, and quarantine practices. Hand-washing rules, theologically sanctioned quarantine of leprosy sufferers (e.g., in Leviticus 13), and certain health-related societal responses to the 1346 Black Death plague in Venice and Marseilles exemplify this public health approach.<sup>1,2</sup>

The miasma era first evolved in England, in part as a result of the adverse public health impacts of the industrial revolution.<sup>3</sup> Edwin Chadwick's *Report on an Inquiry into the Sanitary Condition of the Labouring Population of Great Britain* demonstrated the overwhelming influence of filthy environmental conditions on adverse health outcomes, and it facilitated the formalization of En-

gland's Public Health Act in 1848.<sup>4</sup> Chadwick's report detailed environmental conditions in Britain, together with data to correlate sanitation trends with variations in mortality rates and economic status, thus laying the foundations of modern epidemiology and surveillance.<sup>5,6</sup> Although Chadwick's opinion that most diseases result primarily from sordid environmental conditions was eventually proved to be incorrect, his approach to the safeguard of the public's health is, for the most part, as valid today as it was 160 years ago. For instance, dengue, which was once close to elimination in the Western Hemisphere, now plagues all of South America, primarily because of the rapid growth of cities with poor water supply, sewage disposal, and sanitation.<sup>7</sup>

Following his landmark study of the etiology of tuberculosis in 1882, Robert Koch proposed that fulfillment of the following "germ theory" postulates were necessary in order to demonstrate the parasitic nature of a disease: "The organism must be shown to be constantly present in characteristic form and arrangement in the diseased tissue, the organism which, from its behavior appears to be responsible for the disease, must be isolated and grown in pure culture, and the pure culture must be shown to induce the disease experimentally."<sup>8</sup>

The contagion era facilitated improved understanding of the pathogenesis of infectious diseases like cholera. Such understanding stimulated improved water filtration practices in large urban water supplies and resulted in major de-

creases in morbidity and mortality from intestinal infections. In addition, advances in bacteriology provided a solid foundation for contemporary measures to control the outbreak of communicable diseases and laid a scientific basis for vaccination.

The preventive medicine era extended the contagion control era in several ways. First, it took appropriate account of the concept of disease vectors. Second, it recognized that not all microbes were dangerous; indeed, some were necessary for healthy bodily function. Third, it highlighted the role of nutrient deficiencies (e.g., of iodine and vitamins) in impairing optimal health. It was during this era that public health activities became centered on "high-risk" population groups such as schoolchildren, pregnant women, and the elderly.<sup>9</sup> The establishment in 1948 of Britain's National Health Service formalized the principles of the preventive medicine era and facilitated their widespread adoption through physicians' enhanced ability to shape political and public perceptions of health policy issues and by incorporating a professional (medical) bias into the perspectives of key politicians and policymakers.<sup>10</sup>

The key elements of the primary health care era, as formalized by the 1978 Alma-Ata Declaration, were (1) global cooperation and peace as important aspects of primary health care; (2) recognition that primary health care should be adapted to the particular circumstances of a country and the communities within it; (3) recognition that

**TABLE 1—Six Eras in the Evolution of Public Health**

Public Health Era	Dominant Paradigm	Analytic Approaches	Action Frameworks	Legacies Incorporated Into Contemporary Public Health
1. Health Protection (antiquity–1830s)	Diseases may be prevented by enforced regulation of human behavior, mediated through societies' social structures.	Interpretation/promulgation of religious and cultural rules that are thought by the ruling elites to protect the health of the individual and the community.	Enforcement of spiritual practices, community taboos, customs, and quarantine.	Quarantine of illegal migrants; enforcement of some environmental protection laws; aspects of spirituality in prevention and coping with disease; some occupational and transport safety laws.
2. Miasma Control (1840s–1870s)	Addressing unsanitary environmental conditions may prevent diseases.	Demonstration that poor health and epidemics resulted directly from unsanitary physical and social environments.	Centralized action to improve environmental sanitation; public health legislation relating to minimum standards for drainage, sewage, and refuse disposal.	Aspects of Healthy Cities initiatives; potable water and sanitation programs; legal framework for implementing public health activities; foundations of modern epidemiology and surveillance.
3. Contagion Control (1880s–1930s)	Germ Theory: positivist approach to demonstration of infectious origins of diseases.	Demonstration of the presence of disease-causing microorganisms in infected media, their isolation, and experimental transmission.	Interruption of disease transmission through improved water filtration processes; vaccination; standardized disease outbreak control measures.	Evidence-based public health practice; ethical vaccination practices; foundations for international cooperation in health; foundations for modern chemotherapy.
4. Preventive Medicine (1940s–1960s)	Improvements in public health through focus on the prevention and cure of diseases in “high-risk groups.”	Definition of, and interventions aimed at, main avenues for disease transmission. Medical dominance, with focus on treatment of communicable diseases and primary care of “special populations” (e.g., pregnant women and factory workers).	Environmental interventions directed at disease vectors such as mosquitoes; identification and use of “useful” microbes; enhanced medical care for “high-risk groups”; foundations of modern clinical pathology.	Focus on “high-risk groups” in the planning and implementation of public health programs; improved understanding of the pathogenesis of communicable and noncommunicable diseases.
5. Primary Health Care (1970s–1980s)	Health for All: effective health care geared toward the community, for the community, and by the community.	Largely preventive health care approach, underpinned by emphasis on equity, community participation, accessibility of services, and social determinants of health.	Emphasis on global cooperation and peace; adapting health services to countries and communities; links between health care and socioeconomic development; intersectoral cooperation in health promotion and disease prevention; equity in health care.	Concepts underpinning multicultural health and Healthy Cities initiatives, health inequalities, and community participation in health promotion activities.
6. Health Promotion (1990s–present)	Advocacy for health; enabling individuals and communities to attain optimal health.	Individuals and communities may be assisted by educational, economic, and political actions to increase control over, and improve, their health through attitudinal, behavioral, social, and environmental changes.	Encapsulated by the key action areas of the Ottawa Charter: build healthy public policy; create supportive environments; strengthen community action; develop personal skills; and reorient health services.	

health care reflects broader social and economic development; (4) primary health care as the backbone of a nation's health

strategy, with an emphasis on health promotion and disease prevention strategies; (5) achievement of equity in health status;

and (6) involvement of all sectors in the promotion of health.<sup>11</sup> The health promotion era was formalized by the 1986 Ottawa

Charter, which advocated the need to increase opportunities for people to make healthy choices with regard to specific

disease-precipitating factors by providing them with health information and education and enhancing their life skills. The charter affirmed that health promotion policy combines diverse but complementary approaches, including legislation, fiscal measures, and organizational change. It classified the concerns of health promotion into 5 key areas: to build healthy public policy, to create supportive environments, to strengthen community action, to develop personal skills, and to reorient health services.<sup>12</sup>

By the early 1990s, there was general agreement within the public health community that health promotion, based on the Ottawa Charter principles, constituted the “new public health.”<sup>13,14</sup> Yet analysis of the health promotion framework reveals the legacies of previous eras, thus prompting the question, “What’s new about the ‘new public health?’” In addressing this question, I demonstrate that original health promotion innovations, and the legacies of previous eras, are “new” in the sense that the latter have been revised in the light of advances in knowledge, increasing concerns about human rights, and emerging threats to health.

## LEGACIES AND INNOVATIONS IN HEALTH PROMOTION

The term “health promotion” describes the health education interventions and related organizational, political, and economic interventions that are designed to facilitate behavioral and environmental changes to improve health. Health promotion is generally viewed as having 3 core components: health education, prevention, and protection.<sup>15,16</sup>

The term “health promotion” itself is a legacy of the preventive medicine era; it was first used by Dr Henry Sigerist, who described it as one of the several major tasks of medicine.<sup>17</sup> Its current use is new not only in its being a distinct professional discipline, but also with regard to its mission.

Quarantine practices exemplify the manner in which health protection activities have been incorporated into the new public health. While quarantines continue to serve their basic function, confining diseased individuals as a means of halting infectious disease transmission, the historic legacy of the practice as intensifying stigma and stifling individual autonomy<sup>18</sup> is currently being superseded by more humane and less stigmatizing measures. Furthermore, scientific and legal advances have made more targeted measures possible, as the nature of a given threat to public health becomes better defined (e.g., the response to the recent outbreak of severe acute respiratory syndrome [SARS]). Also, article 7 of the World Health Organization (WHO) International Health Regulations provides clear guidelines on when to declare the end of epidemics in defined communities, thereby limiting the risk of perpetual stigmatization of regions from which epidemics arise.

These improvements have significantly facilitated the diminution of stigma and promoted voluntary compliance among quarantined individuals and groups. Individual autonomy vis-à-vis quarantine has also been enhanced in the new public health. For example, Australia’s recently introduced Quarantine Amendment (Health) Bill 2003 stipulates that people ordered to be quarantined in Aus-

tralia on health grounds now have the right to request independent medical assessment, thus protecting them against arbitrary detention.

The use of legislation to effectively implement contemporary public health activities such as tobacco control is a legacy of the miasma era. Current centralized systems of environmental protection also owe a lot to Chadwick’s initiatives. His broad attribution of the cause of ill health to environmental and social factors, rather than the specifics of biology, constitutes the foundation of current concerns with “social determinants of health.” However, unlike in Chadwick’s time, when legislation suggested that environmental sanitation was essentially a responsibility of government, it is now seen as a responsibility shared by individuals, community groups, and governments. Currently, most government agencies charge individuals and communities for environmental sanitation services such as garbage disposal, and stiff penalties usually apply to those found to have breached environmental protection laws.<sup>19</sup>

The contagion era provided the impetus for evidence-based public health practice, especially through improved understanding of the microbiology and pathogenesis of communicable diseases. These advances laid a scientific basis for vaccination. In the new public health, social marketing and persuasion have transcended legal enforcement as the key to improving vaccination coverage. The latter approach was tried during the contagion and preventive medicine eras, with strident opposition from anti-immunization lobbies. Interestingly, current “consumer par-

ticipation” strategies are not entirely free of opposition.<sup>20</sup>

Robert Koch, and to a lesser extent Edwin Chadwick, were rigid adherents to the “monocausal” doctrines they espoused. Consequently, their towering influence complicated efforts to revise erroneous aspects of their theories in the light of new knowledge.<sup>6,21</sup> General acceptance of the concept of social determinants of health, as well as the multidisciplinary nature and generally horizontal hierarchy of the contemporary health promotion workforce, has diminished the potential adverse impact of their rigid stances.

Physicians of the preventive medicine era made innovations in the fields of epidemiology, statistics, pharmacology, nutrition, bacteriology, and pathology, from which contemporary public health has benefited immensely.<sup>6,22</sup> The era’s focus on high-risk groups is currently being reframed in efforts to address the generally inferior health status of prisoners and indigent populations.<sup>23,24</sup> However, contemporary health promotion rightly accords greater attention to social determinants of health than was the case during the preventive medicine era.<sup>25</sup> In addition, the dominance of the medical profession in public health, which characterized the preventive medicine era, is being superseded by a multidisciplinary approach, with sociologists, health economists, and health promotion specialists now sharing the limelight with public health physicians.

The health promotion era appears to be a continuation of the primary health care era, couched in phrases that appeal more to rich nations and donor organizations. Although the key concepts

of the Alma-Ata Declaration are essentially coterminous with the Ottawa Charter, the Alma-Ata Declaration emphasizes issues that are of major significance to developing countries (e.g., affordable health care, food security, and an emphasis on global peace), whereas such issues are presented as subscribers in the Ottawa Charter. Ironically, while technical experts appointed by the WHO to review the implementation of the Alma-Ata Declaration in developing countries assessed the framework as unwieldy and instead suggested a selective approach,<sup>26</sup> the core principles of health promotion currently endorsed by the WHO—empowerment, equity, collaboration, and participation<sup>27</sup>—are even more imprecise.

## CONCLUSION

Unlike other paradigms that gained acceptance by demonstrating a more robust and appropriate framework than those they displaced, contemporary health promotion suffers from a “crisis of legitimacy.” Critics view it as providing a functionalist framework that detracts from the need for longer-term social, economic, and political change, as succinctly advocated by the Alma-Ata Declaration.<sup>27</sup> Apparently in response to this criticism, health promotion leadership has tried to accommodate key players and concepts of all previous eras under its umbrella—a “total public health” approach.<sup>25</sup> However, rather than help consolidate its position, this approach has blurred the dominant paradigm and mission of health promotion, as evidenced by a lack of generally agreed upon definition or philosophical underpinning and a lack of unanimity as to whether or

not health promotion is the new public health.<sup>29,30</sup> Consequently, most countries currently operate parallel systems of public health and health promotion, unlike in most previous eras, when the dominant paradigm and public health were generally coterminous.

What is new about the new public health is not the originality of strategies to ensure healthy conditions, but the manner in which health promotion discourse has adapted core doctrines of previous eras to address the public health threats of our era. New public health eras usually arise when the dominant public health framework becomes obsolete as a result of changing health patterns and advances in health knowledge. Currently, public health theorists and commentators appear to be losing confidence in the capacity of the health promotion paradigm to effectively address major contemporary public health threats, such as health inequalities and terrorism.<sup>31,32</sup>

Reform of the contemporary health promotion framework, and a possible progression into a more responsive era that would better address new and emerging threats, should be considered from several perspectives. First, there is a need to define the philosophical basis of contemporary public health, thereby facilitating more effective monitoring of public health functions and a more secure basis for advocacy of public health funding.<sup>33,34</sup> Second, there is a need to determine who exactly is a public health worker or specialist. This would better define workers’ roles and responsibilities, and facilitate cohesion within the discipline. Although the International Union for Health Promotion and Education’s strategic directions for

2002 through 2007 (available at <http://www.iuhpe.org>) indicate that implementing healthy public policies is “an overriding concern” for health promotion, the new public health generally values social change advocates (vital players in such implementation) less than workers in established specialties such as epidemiology and public health medicine. There is a need to acknowledge public health workers and activists who “lead from the front,” rather than overrelying on the hierarchical structures of previous eras.

Third, previous characterizations of public health as “global” prior to the primary health care era are inaccurate, reflecting more the views of former empire states than the realities outside the spheres of major influence of these defunct empires. The failed implementation of primary health care as an instrument of global public health highlights the difficulties in developing a truly global public health framework. As an international framework, the health promotion paradigm has not fared better—most of its supposedly successful concepts have proved unworkable outside the affluent, largely homogenous societies in which they were pilot-tested.<sup>35,36</sup> Indeed, public health is essentially an expression of the ways different societies address questions of social order and nationhood. By first addressing the structures of power and socioeconomic development within the history of national and regional cultures, the suitability of implementing specific public health paradigms might become clearer.<sup>37</sup>

Finally, because of the health promotion paradigm’s functionalist orientation, it probably could not ensure healthy conditions for people in the 21st century.<sup>28,38</sup>

Today’s world is characterized by intractable problems of poverty, global inequality, emerging diseases, and persistent conflicts<sup>39</sup>—issues that require more radical public health frameworks than that of the new public health. A historical–structural framework should provide a more resilient basis for contemporary public health workers to prevent diseases and save lives locally using practical, cost-effective techniques. At the same time, it should facilitate global prophylaxis against communicable health threats. It is not necessary for such frameworks to be uniformly implemented worldwide, as the primary health care and health promotion eras have unsuccessfully attempted to do. These are the challenges that await the next “new public health.” ■

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# Professional and Hospital DISCRIMINATION

## and the US Court of Appeals Fourth Circuit 1956-1967

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**Pursuit of a legal strategy against racist policies was an essential element in a national campaign to eliminate discrimination in health care delivery in the United States.**

| P. Preston Reynolds, MD, PhD, FACP

**AS LATE AS THE MID-1960S**, hospital discrimination was widespread throughout the United States and, in many jurisdictions, legally sanctioned. Discrimination was expressed through denial of staff privileges to minority physicians and dentists, refusal to admit minority applicants to nursing and residency training programs, and failure to provide medical, surgical, pediatric, and obstetric services to minority patients. A national campaign to eliminate hospital discrimination involved collaboration among professional associations; public health, hospital, and civil rights organizations; and the federal government, along with a direct attack against hospital policies through litigation that culminated in 2 landmark judicial decisions. These legal decisions, one involving a hospital in North Carolina and the other a hospital in Virginia, both emerged from the US Court of Appeals Fourth Circuit.

This article describes a series of court cases, all litigated by the

National Association for the Advancement of Colored People (NAACP) Legal Defense and Education Fund between 1956 and 1967, that laid the foundation for elimination of overt discrimination in hospitals and professional associations. The first landmark case, *Simkins v Moses H. Cone Memorial Hospital* (1963), challenged the federal government's use of public funds to expand and maintain segregated hospital care. The second case, *Cypress v Newport News Hospital Association* (1967), reaffirmed the federal government's application of the Medicare certification guidelines to force hospitals to open up patient admissions, education programs, and staff privileges to all citizens and physicians regardless of race, color, or national origin. Successful pursuit of a legal strategy against racist hospital policies and practices was an essential element in a national campaign to eliminate discrimination in health care delivery in the United States.

### FEDERAL POLICIES OF "SEPARATE BUT EQUAL" IN HOSPITAL CONSTRUCTION AND PATIENT CARE

At the close of World War II, the nation embarked on a large-scale initiative in hospital construction commonly referred to as the Hill–Burton program. The Hospital Survey and Construction Act, passed in 1946, authorized \$75 million per year for 5 years for grants to states for hospital construction beginning in 1947, plus \$3 million per year for state surveys of hospital facilities. As a federal–state partnership, state agencies were given an initial grant to assess how best to apportion construction funds on the basis of population distribution and existing hospital beds. Federal dollars without control over hospital administrative policies was the guiding principle.<sup>1</sup>

In congressional debates on the proposed Hill–Burton Act, National Association for the Ad-

vancement of Colored People (NAACP) Chairman Dr Louis T. Wright and other Northerners, particularly Senators William Langer (Republican, North Dakota) and Harold Burton (Republican, Ohio), called for nondiscrimination in the use of federal funds, or no money to hospitals that practiced segregation. Southerners, such as Senator Lister Hill (Democrat, Alabama), argued for states' rights or the right of state legislatures and local hospital authorities to set policy. A compromise was struck with inclusion of legislative language that allowed for "equitable distribution of hospital beds for each population group," or "separate but equal" as applied to hospital construction.<sup>2</sup> It would be the "separate but equal" clause of the Hill-Burton Act that would come under legal attack on the grounds that it violated the 5th and 14th Amendments of the US Constitution.

Over the next 10 years, with steady growth of funding for hospital construction made possible by Congress, the medical and hospital leadership gradually reversed the country's shortage of general hospital beds, but not its practices of hospital discrimination. Dr Paul Cornely, chair of the Department of Preventive Medicine and Community Health at Howard University, published in 1956 his survey of 60 National Urban League chapters—45 in the North and 15 in the South—designed to determine the extent of segregation in hospitals. He found that in the North, hospital integration was common, with 83% of hospitals reporting they provided some degree of integrated services. In the South, however, only 6% of hospitals offered Blacks services without restrictions; 31% did not

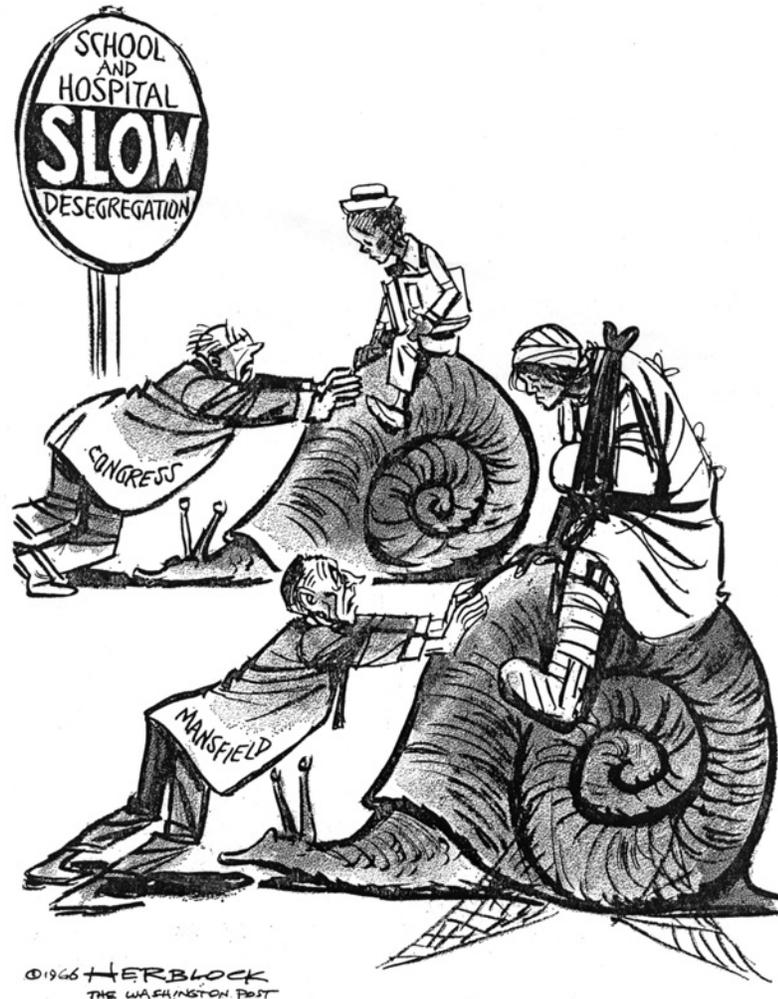
admit Blacks under any conditions, even emergency; 47% had segregated wards for Whites and Blacks; and 16% had modified patterns of segregation that changed with the ratio of Whites and Blacks admitted at any one time.<sup>3</sup>

Throughout the North and South there were 3 architectural patterns of hospitals where Blacks found admission. One was the "all-Black" hospital built solely for the care of minority persons living in a community. The "mixed-race"

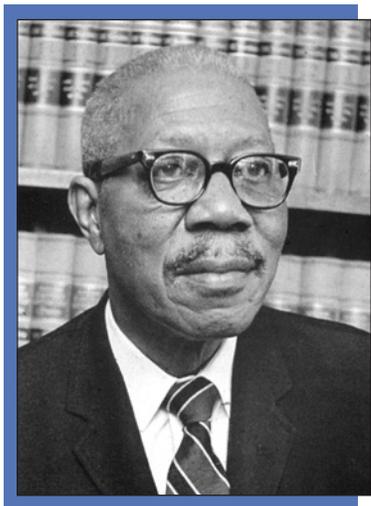
hospital segregated Black patients onto a separate floor such as a basement or attic ward, a wing, or a building connected to the main hospital often via an exposed corridor. The fully integrated hospital, while rare even in the North, admitted Blacks to any available hospital bed, including beds in semiprivate and private rooms. If Blacks were admitted to a ward located on one end of a long corridor and Whites to a ward on the other end, one could not assume that these patient areas

**Unlike schools, the Department of Health, Education and Welfare refused hospitals permission to submit "Go Slow" plans and demanded immediate integration prior to Medicare certification in 1966. Strong opposition to these changes surfaced within the Senate. The Fourth Circuit Court in *Cypress v Newport News Hospital Association* (1967) reaffirmed the federal government's use of the Medicare racial integration guidelines to reverse decades of overt hospital discrimination.**

"Go Back! Go Back! This Pace Is Making Us Dizzy"



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Source: North Carolina State Bar Quarterly

**Conrad Odell Pearson, JD.** Conrad Pearson, a graduate of Howard University Law School, served as the NAACP Legal Defense and Education Fund, Inc., general counsel for the state of North Carolina, and as such was involved in nearly every civil rights case submitted into the state's federal court system for over thirty years.

“Working from his office on Chapel Hill Street in Durham, Pearson began his legal career by attacking public institutions in North Carolina that operated on a conventional system of discrimination against Blacks.”

were mirror images. Instead, new beds, air conditioning, and fresh paint added comfort to the quarters where Whites recuperated. In White sections, nurse staffing also was better and visiting hours for family members longer. While White physicians could care for patients in any bed—ward or private, Black or White—African American physicians, if granted admitting privileges, were restricted to the Black wards.

Born in Greensboro and raised in Durham, NC, Conrad Odell Pearson emerged as an important figure in the legal attack against hospital discrimination. After attending public schools in Durham, Pearson received his undergraduate degree from Wilberforce University in Ohio. He obtained his legal education at Howard University, passing the North Carolina State Bar Examination before completing his final year at Howard, and then graduated in 1932 in the same class with Thurgood Marshall. Like many others, Pearson came under the influence of the young vice dean (later dean) of the law school, Charles Hamilton Houston, who shaped Howard University Law School into a powerful training ground for activist lawyers grounded in the use of constitutional theory to overturn decades of Jim Crow laws. Conrad Pearson would emerge as one of his most productive protégés.

Working from his office on Chapel Hill Street in Durham, Pearson began his legal career by attacking public institutions in North Carolina that operated on a conventional system of discrimination against Blacks. The year following his graduation from Howard, Pearson began preparing *Hocutt v University of North Carolina*, the first suit seeking admission of a Black student to a

southern state university. That same year, he successfully fought the systematic exclusion of Blacks from North Carolina juries in *State v Tucker*. Soon after *Tucker*, Pearson established a closer association with his former law school classmate, Thurgood Marshall, and the NAACP.<sup>4</sup>

For tax purposes, in 1939, the legal team working at the NAACP split off, forming a separate corporation and renaming themselves the NAACP Legal Defense and Education Fund, Inc. Although still housed in adjacent quarters in New York City, the Legal Defense Fund grew into an independent organization known for its legal advocacy against discrimination and injustice.<sup>5</sup> Conrad Pearson became the first NAACP Legal Defense Fund lawyer for the state of North Carolina, serving as a direct link between the state and the New York office. As such, he was involved in nearly every civil rights case filed in the federal court system in North Carolina from the mid-1930s through the late-1960s.<sup>6</sup> Although Pearson is remembered as a pioneer defender of civil rights, his defenses often took the nature of a series of offensives on institutional segregation.

### CONSTRUCTING THE IDEAL “TEST CASE” IN HOSPITAL DISCRIMINATION

In May 1956, attorney Conrad Pearson filed on behalf of 3 physicians and 2 patients a class action suit, *Hubert A. Eaton et al. v Board of Managers of James Walker Memorial Hospital et al.* The suit charged James Walker Memorial Hospital with discrimination for denying Black physicians staff privileges because of

their race, thus rendering them unable to care for their patients in this hospital.<sup>7</sup> District Court Judge Donald L. Gilliam held the first hearing 23 months later. Pearson argued state action in the affairs of the hospital because it paid no taxes, and because James Walker originally gave it to the city as a public facility. One month later, Judge Gilliam dismissed the case, believing there was insufficient evidence that this private hospital was fulfilling a state function.<sup>8</sup> It had never used Hill–Burton funds.

The NAACP Legal Defense Fund lawyers appealed the case before the US Court of Appeals Fourth Circuit using much the same argument. The Fourth Circuit Court affirmed the District Court decision on November 29, 1958.<sup>9</sup> Taking the next step, the Legal Defense Fund team petitioned the Supreme Court for writ of certiorari, or a request that the highest court accept the case for argument. While the Supreme Court denied writ, 3 justices, including Chief Justice Earl Warren, wrote in a dissent that certiorari should be granted. The NAACP lawyers realized just how unusual this was and set out to find their ideal “test case” for argument before the Circuit Court and potentially before the Supreme Court justices.<sup>10</sup> They did not wait long or look far.

George Simkins, DDS, a dentist in Greensboro, NC, was a leader in the Black community and well-known to the NAACP. He grew up in Greensboro, where he attended public schools before matriculating into Herzl Junior College in Chicago and then Talladega College, from which he graduated. He earned his dentistry degree from Meharry School of Dentistry in 1948 and completed a rotating

internship at Jersey City (NJ) Medical Center. Upon returning to Greensboro, he opened a private dentistry practice and joined the Guilford County Health Department, becoming the first African American so employed there.

Simkins was not only a well-known and respected dentist but also a nationally ranked badminton player. He had spearheaded efforts to racially integrate the public golf course and schools in Greensboro and served as president of the local NAACP chapter.<sup>11</sup> Frustrated with the crowded conditions and less modern facilities and equipment at L. Richardson Memorial Hospital, the “all-Black” hospital, Simkins called the NAACP Legal Defense Fund, inquiring whether anyone would help break down the discriminatory admitting privileges that existed at Moses H. Cone Memorial Hospital and Wesley Long Hospital.

The legal argument that would be used in the *Simkins* case did not rest on the inequality of facilities at L. Richardson Memorial Hospital compared with those at Moses H. Cone and Wesley Long Hospitals. From 1946 to 1963, only 70 of 7000 Hill-Burton construction projects were built as “separate but equal” facilities, or as either “all-White” or “all-Black” hospitals or renovation projects.<sup>12</sup> While all other recipients of Hill-Burton funding had executed an assurance of nondiscrimination, most denied Black physicians and dentists admitting privileges and segregated Black and White patients into separate wards.<sup>13</sup>

The critical difference between James Walker Memorial Hospital and Cone and Wesley Long Hospitals was the use of Hill-Burton funds by the latter 2

institutions. It was not so much the amount of funds they had used in the past, but that these federal dollars had been distributed on the basis of statewide surveys of population needs for hospital beds approved by the surgeon general of the US Public Health Service under the authority of the Hill-Burton program. Between 1946 and 1963, 350 Hill-Burton projects were authorized for funding in North Carolina alone, with a state allocation of \$180.9 million and a federal contribution of \$77.85 million.<sup>14</sup> This, the NAACP Legal Defense Fund lawyers argued, was state action in the operation of these private hospitals.

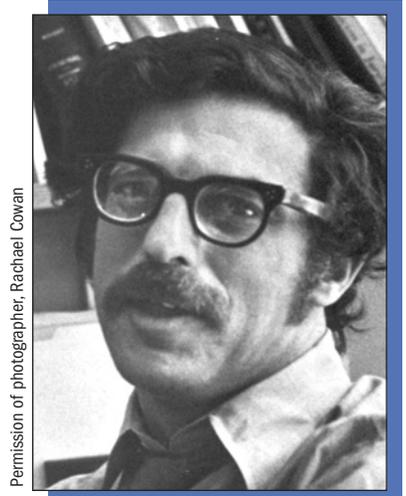
As the NAACP Legal Defense Fund state attorney, Conrad Pearson filed the suit on February 12, 1962, in honor of Abraham Lincoln’s birthday.<sup>15</sup> Despite the dismissal of the suit at the District Court level on December 5, 1962, the New York-based Legal Defense Fund team appealed to the Fourth Circuit Court and argued their case before Chief Justice Simon E. Sobeloff and Judges Herbert S. Boreman, Clement F. Haynsworth, Albert V. Bryan, and J. Spencer Bell.<sup>16</sup> Once the NAACP lawyers could effectively argue state action, or federal involvement, in the affairs of a private institution, they were in a position to seek on behalf of the plaintiffs protection against discrimination under the 5th and 14th Amendments of the US Constitution. Furthermore, with state action proposed and relief against discrimination requested, the federal government could choose whether or not to render an opinion in the case. In a historic move, Assistant Attorney General Burke Marshall submitted a

lengthy brief that supported the position of the Black dentists, physicians, and patients. The federal government agreed that the use of federal funds in a discriminatory manner was unconstitutional and that these professionals and patients should be granted the privileges and services they sought.<sup>17</sup>

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Chief Justice Sobeloff led the charge to overturn years of legal decisions that held in place an elaborate system of discriminatory hospital care. Initially, the majority of the Fourth Circuit Court judges did not support the position taken by the Office of the Attorney General, but over several months of deliberation and drafts of the decision, Sobeloff convinced Judge Bryan to change his vote. In the end, Judge Sobeloff secured Judges Bell and Bryan to vote with him, with Judges Haynsworth and Boreman dissenting.<sup>18</sup> The legal argument developed by Michael Meltner, junior associate in the NAACP Legal Defense Fund, prevailed, as Sobeloff wrote in *G. S. Simkins, Jr et al. and the United States, Intervenor v Moses H. Cone Memorial Hospital et al.*:

The massive use of public funds and extensive state-federal sharing in the common plan are all relevant factors. We deal here with the appropriation of millions of dollars of public



Permission of photographer, Rachael Cowan

**Michael Meltner, JD.** Michael Meltner as junior associate of the NAACP Legal Defense and Education Fund, Inc., developed the legal argument that proved successful before the US Court of Appeals Fourth Circuit in the landmark *Simkins v Moses H. Cone Memorial Hospital* (1963) case.

monies pursuant to comprehensive governmental plans. . . . The issue is not equality or lack of equality in “separate but equal” but the degree of participation by the national and state government in the geographical proration of hospital facilities throughout the state.<sup>19</sup>

Heralded by many as a landmark case, *Simkins* became the *Brown v Board of Education* decision for hospitals. Between 1963 and 2001, there were over 260 references to *Simkins* in other legal decisions, more than any other case involving hospital racial discrimination.

And yet its reach was limited because the US Supreme Court denied writ of certiorari, and thus only those hospitals that were proposed or under construction in the jurisdiction of the Fourth Circuit Court (Maryland, Virginia, West Virginia, North Carolina, and South Carolina) were legally obligated to racially integrate their services. And the new Hill–Burton regulations did not apply to those hospitals that already had used federal funds. Nevertheless, in March 1964, the surgeon general published regulations that stated the following:

53.112 Before . . . approval, the State agency shall obtain assurances from the applicant that all portions and services of the entire facility for the construction of which, or in connection with which, aid under the Federal Act is sought, will be made available without discrimination on account of race, creed, or color; and that no professionally qualified person will be discriminated against . . . with respect to the privilege of professional practice in the facility.<sup>20</sup>

The role of *Simkins* in strengthening other court cases against hospital discrimination is unquestionable. In North Carolina, Dr Hubert Eaton had refiled his case against James

Walker Memorial Hospital in July 1961. The New York–based Legal Defense Fund lawyers developed a new set of arguments that would extend the *Simkins* decision to all hospitals, including those that had not used Hill–Burton funds. They argued for state action in James Walker Memorial Hospital because of 4 conditions: (1) James Walker gave ownership of the hospital to the city and county under the condition that the hospital be maintained as a public facility; (2) the hospital both enjoyed a tax exempt status and received money from the county to expand the facility and to cover the costs of charity care; (3) the hospital had accepted money under the federal Defense Public Works Act with the stipulation that it adhere to nondiscrimination provisions; and (4) the hospital participated in the Hill–Burton statewide plan for hospital beds, although there was no direct use of funds.

As before, the District Court dismissed the case in April 1963, because “the factual situation here does not differ from the first *Eaton* case, and that there has been no intervening change in the law.”<sup>21</sup> On appeal, Jack Greenberg of the Legal Defense Fund argued the case before Chief Justice Sobeloff and Judges Haynsworth, Boreman, Bryan, and Bell. In a unanimous decision on April 1, 1964, the Fourth Circuit Court reversed the lower court ruling. As Judge Herbert S. Boreman admitted, “Although I am still conscious of a lingering doubt as to the correctness of the holding in *Simkins*, I recognize the binding effect of that decision on members of this court. . . . Therefore, I unhesitatingly concur with the opinion and join the

judgment.”<sup>22</sup> Legal opinion clearly had shifted.

Between July 2, 1960, and March 1, 1966, the NAACP Legal Defense Fund maintained about 35 cases against southern medical facilities. The fund worked hard with state attorneys to identify noncompliant hospitals that could be submitted as cases to the courts, and that could be used to pressure the Department of Health, Education and Welfare (HEW) to develop a rigorous compliance program, first under the Hill–Burton program and then under Title VI of the 1964 Civil Rights Act.<sup>23</sup> With the success of both *Simkins* and the second *Eaton* case, the Legal Defense Fund lawyers now could use either template when putting forward hospital discrimination cases in other circuit courts. Their goal was simple: to extend the reach of the law to hospitals throughout the country and to force into public discussion the failure of hospitals and other health care facilities to comply with federal regulations and state and national laws.

## THE LIMITS OF VOLUNTARY COMPLIANCE

The filibuster that nearly defeated the 1964 Civil Rights Act was the longest in this nation’s history.<sup>24</sup> Racism was not going to die easily, if ever. President Lyndon B. Johnson depended on Vice President Hubert Humphrey for passage of this legislation and would call on him again for help with the Medicare hospital certification program. On July 2, 1964, President Johnson signed into law the Civil Rights Act. HEW was the first federal agency to draft new regulations for Title VI that forbade the distribution of any federal funds to

institutions or state agencies that discriminated against minority populations. Approved by President Johnson in December 1964, these regulations became effective one month later and served as the model for other federal agencies.<sup>25</sup> With one clean move, Title VI gave 21 federal departments and agencies explicit mandate to withhold funds from grantees that discriminated, and by the fiscal year ending June 30, 1966, Title VI conditioned \$18 billion in federal aid on nondiscrimination.<sup>26</sup> While the federal government had authority to withhold funds from noncompliant institutions and agencies, voluntary compliance with racial integration was the goal.

Despite many efforts, beginning in the early 1950s, to secure through voluntary action full membership in the North Carolina Medical Society and the North Carolina Dental Society, Black physicians and dentists still had no success.<sup>27</sup> Consequently, they were denied opportunities to serve on state licensing boards of examination and the North Carolina Medical Care Commission, which turned to the 2 all-White state professional societies for nominees. Black professionals also were denied hospital privileges that depended on membership in the local chapters of these state branches of the American Medical Association and American Dental Association. Reginald Hawkins, DDS, a Black dentist, refused to wait any longer and in 1963, as an individual, filed a class action suit against the North Carolina Dental Society for discrimination in membership. Predictably, the District Court dismissed the case on June 19, 1964, and the US Court of Appeals Fourth Circuit ruled in

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favor of Dr Hawkins on January 20, 1966. Again, the opinion written by Judge Simon Sobeloff summarized the discrimination that Black professionals faced at every turn:

Dr Hawkins' application was not even considered, however, for he could not obtain the endorsements of two of the white members of the Society. Under the circumstances when the Society's membership was racially exclusive and the recommendation of no Negro acceptable, rigid enforcement of endorsements by members of the Society is itself a discrimination because of race.<sup>28</sup>

Dr W. Montague Cobb, president of the National Medical Association in 1964, praised the leadership of Dr Hubert Eaton, Dr George Simkins, Dr Reginald Hawkins, Dr Roy Bell (who filed a suit similar to the one filed by Dr Reginald Hawkins), and Jack Greenberg (chief legal counsel of the NAACP Legal Defense and Education Fund) in establishing legal precedent for the racial integration of hospitals and professional societies. In reality, however, the racial integration of America's hospitals had just begun.

John Gardner, appointed secretary of HEW in December 1965, once described the set of challenges he faced in racially integrating this country's private

and public institutions as “a series of great opportunities disguised as insoluble problems.” In July of that year, President Johnson had signed into law the Medicare Act that would become effective one year later. Secretary Gardner would need to guarantee America's elderly citizens access to thousands of hospitals that now had less than 6 months to racially integrate to receive federal funds under this national program. The task was enormous, but justification for withholding federal funds to noncompliant institutions was established legally through *Simkins* and the second *Eaton* case and was reinforced further by federal regulations under Title VI of the 1964 Civil Rights Act.<sup>29</sup>

By April 1966, the leadership of HEW and the Social Security Administration knew they faced an impending disaster. Survey data revealed that only 42% of all hospital beds in the country were in hospitals that complied with Title VI and were thus available for Medicare recipients.<sup>30</sup> Medicare was the largest and perhaps most important program of President Johnson's Great Society. He had flown to Missouri to sign the legislation in the company of former President Harry Truman, and yet hospitals throughout the South threatened to keep their doors closed to



**President W. Montague Cobb, MD, PhD, at the 1964 annual meeting of the National Medical Association awarding certificates to the physicians and dentists and chief counsel of the NAACP Legal Defense and Education Fund Inc for their courage in filing suits to reverse discriminatory policies and practices against black professionals and patients.**

Blacks, which would make them ineligible to participate in Medicare. In fact, fewer than 10% of hospitals in Louisiana, Mississippi, Virginia, and South Carolina; between 11% and 15% of hospitals in Georgia, Alabama, and Florida; and just over 20% of hospitals in North Carolina were compliant with new federal hospital integration guidelines. In response, HEW and the Social Security Administration launched an assault on hospital discrimination. Over a period of several months, 3000 of 7000 hospitals underwent site visits by federal investigators to pressure them to comply with hospital racial integration guidelines<sup>31</sup>(Table 1).

Their full-scale campaign was successful: on the eve of the start of Medicare, 14 states and 3 territories had 100% compliance. Of the southern states, 6 had more than 85% of their beds available for Medicare recipients and thus for all Americans, Black or White.<sup>32</sup> The job of hospital racial integration, however, was not finished. On the other end of the spectrum, Virginia reported

that only 47% of its hospital beds were located in hospitals compliant with Medicare guidelines. While the Medicare hospital certification program eliminated overt discrimination in many hospitals throughout the country, racist policies and practices still existed in many others.

In September 1966, Senator John C. Stennis (Democrat, Mississippi), chairman of the Appropriations Committee, used his position to attach an amendment to the appropriations bill that would allow physicians and hospital administrators to continue to segregate patients. The argument put forth was that the medical condition of some patients could be adversely affected if they were placed in the same room with a patient of the opposite race. In these unique cases, the judgment of the physician could be called upon to determine the need for segregated quarters for these patients. More important, Stennis argued that hospitals not be held accountable for these “segregated” patients in calculations performed

by HEW on hospital integration compliance during follow-up site visits, and that these data would not be used when pending approval of hospitals for Medicare certification was determined.<sup>33</sup>

The debate on the Senate floor was predictable. Northern senators, including John O. Pastore (Democrat, Rhode Island), Edward M. Kennedy (Democrat, Massachusetts), Joseph S. Clark (Democrat, Pennsylvania), and Jacob K. Javits (Republican, New York) argued several lines of attack. First, the proposed amendment more appropriately fell under the jurisdiction of the Labor Committee, the Education and Health Subcommittee, or even the Committee on the Judiciary, and thus should not be considered as a rider to the appropriations bill. Second, amendment 207, as written, undermined the Medicare hospital certification guidelines that had been developed and approved with input from several federal agencies, bureaus, and departments. Third, the current language of amendment 207 contradicted Title VI of the Civil Rights Act that Congress had passed and consequently could reverse gains in racial integration thus far achieved. Lastly, it potentially created a loophole large enough “to drive a Mack truck” through.

Senators John Stennis and Lister Hill countered by defending the proposed changes in implementation of the Medicare program. In fact, since Mississippi and Alabama stood as flagrant outliers in Title VI compliance, these 2 senators were doing their job by articulating well the positions of their White constituencies that voted them into office. With the majority of Democrats off the Senate floor in a confer-

ence committee when the amendment came up for vote, it passed.<sup>34</sup>

The House of Representatives, when presented with amendment 207, soundly defeated it. In conference committee, however, Senator Stennis demanded that Secretary Gardner put in writing his willingness to abide by the proposed changes in the implementation of Medicare before he would allow an appropriations bill to emerge free of the amendment. Gardner consented and sent Stennis 3 letters in October that both reaffirmed the Medicare racial integration guidelines and offered to allow physicians to segregate patients for medical reasons without compromising a hospital's Medicare certification. Back on the Senate floor on October 21, Senator Stennis summarized these HEW concessions and asked that copies of Secretary Gardner's letters be published in the Congressional Record.<sup>35</sup>

The legality of the Medicare hospital certification program would be tested in the courts; much to the surprise of many, it was not only upheld but strengthened. Fortuitously, the issue of hospital integration returned to the jurisdiction of the knowledgeable US Court of Appeals Fourth Circuit that had ruled in favor of the minority plaintiffs in both the *Simkins v Moses H Cone Memorial Hospital* and *Eaton v James Walker Memorial Hospital* cases. The second landmark case involved a Black board-certified pediatrician, Dr George Cypress, whose request for clinical privileges at Riverside Hospital in Newport News, Va, was denied in 1961 and again in 1962. A colleague of his, Dr C. Waldo Scott, a Black board-certified general surgeon, was

denied privileges in 1963. More revealing, Dr Cypress was the only Black pediatrician in the community and the only pediatrician denied clinical privileges at Riverside Hospital. Of 18 surgeons in Newport News, all of them except Dr Scott, the only Black surgeon, held clinical privileges at this modern and well-equipped facility.<sup>36</sup>

In a class action suit, Dr Cypress along with 2 of his patients, both stricken with sickle cell disease, sued Newport News Hospital Association for the denial of staff privileges and discrimination in patient room assignments. The District Court dismissed the case on March 14, 1966, claiming "the difficulty . . . is that we do not know what factors were considered in rejecting their applications. . . . If race is the obstacle which brought about their rejection, they should be admitted. With a secret written ballot and no opportunity for a hearing, it is most difficult to determine."<sup>37</sup>

The District Court hedged its conclusion with regard to the failure of Riverside Hospital to assign Black and White patients to the same room, arguing that this was a "complex matter which involves the delicate situation of the patient's feelings as related to his general health."<sup>38</sup> In the spring of 1966, however, Riverside Hospital signed an Assurance of Compliance (Form 441) with the federal government and became certified to participate in Medicare.

The New York-based NAACP Legal Defense Fund lawyers appealed the case to the Fourth Circuit Court, which reversed the District Court decision on March 9, 1967. While Clement F. Haynsworth now served as chief justice, Judge Simon Sobeloff assumed responsibility for writing

the court's opinion, and in preparing for it did a thorough job of researching his subject. He knew of HEW's success in implementing Medicare and its strong position taken on the racial integration of patient rooms, and of Stennis's effort to undermine further progress. Consequently, he worked hard to create a unanimous decision because he believed any dissent would keep open this loophole.<sup>39</sup>

The *Cypress* case involved both assignment of patients to rooms regardless of race, class, or national origin and the granting of medical staff privileges to qualified minority physicians. In proving the existence of discrimination against these board-certified physicians, the NAACP Legal Defense Fund lawyers obtained the expert testimony of leaders in the fields of pediatrics and surgery as well as the judgments of supervisors. Dr Allan Butler, professor emeritus at Har-

**Table 1: Medicare Title VI Hospital Racial Integration Guidelines**

1. That hospitals provide inpatient and outpatient care without regard to race, color, or national origin;
2. That all patients be assigned to rooms, wards, floors, sections and buildings without regard to race, color, or national origin;
3. That employees, medical staff, and volunteers be assigned without regard to race, color, or national origin;
4. That the granting of permanent or temporary staff privileges be carried out in a nondiscriminatory manner;
5. That nondiscriminatory practices prevail in all aspects of training programs and require recruiting and selection of trainees at both predominantly White and Black schools;
6. That administrative services, medical and dental care for in-patients and out-patients, and other services be provided without regard to race, color, or national origin;
7. That employees and medical staff be notified in writing of the hospital's compliance with the Civil Rights Act;
8. That hospitals which end discriminatory practices notify those persons previously excluded from services; and,
9. That hospitals with dual facilities to maintain segregation change the purpose or close one building to insure biracial usage.

vard Medical School and former chief of children's services at Massachusetts General Hospital, was so impressed with Dr Cypress's clinical abilities that he testified he would recommend him to the staff of Massachusetts General Hospital and for a full-time salaried position on the pediatric service of the Metropolitan Hospital of Detroit. Dr Colvin W. Salley, former commanding officer at the army hospital where Dr Cypress had been stationed, testified that in 29 years of practicing medicine he had never been associated with a better pediatrician.

After observing Dr Waldo Scott in the operating room and reviewing his charts, Dr Samuel Standard, professor of clinical surgery at New York University and Bellevue Medical Center, stated that Scott's surgical technique was nearly flawless. When asked if he would recommend Dr Scott to the surgical staff of one of the hospitals where he held responsibility, Dr Standard without hesitation responded, "I would be very happy to have a man of his caliber as an example for a group of residents not only about how to do surgery, which I have no doubt about at all, but also how to live with one's fellow man and his responsibility to surgical care and the grace and the ease with which he carries himself."<sup>40</sup>

In a unanimous decision, the Court of Appeals Fourth Circuit found Drs Cypress and Scott to have exceptional competence, even beyond that of members of the medical staff of Riverside Hospital, and forced the hospital to grant privileges to these qualified minority physicians. Furthermore, the Fourth Circuit Court judges believed the practice of closed balloting was discrimina-

tory and against federal Medicare regulations. With a partial dissent by Judge Albert Bryan of Alexandria, Va, the court ruled that patients could not be segregated into separate rooms under the guise of a serious medical condition when it was apparent that this scheme could be used to perpetuate discriminatory hospital policies and practices. Under the pen of Judge Sobeloff and now under the law, hospitals that participated in Medicare would be held to an even higher standard of compliance with racial integration guidelines. He believed that the Stennis amendment and HEW's concessions were unconstitutional, and therefore he did not even address them in his draft of the court's opinion.<sup>41</sup> The law would allow for no more loopholes and evasions of responsibility. As Sobeloff wrote:

The District Judge asked whether it was "discrimination per se merely because a hospital has deemed fit to place White patients in one ward, Negro patients in another ward?" We answer that it is. . . . Our holding is simply that race cannot be a factor in the admission, assignment, classification, or treatment of patients in an institution like this which is state-supported and receives federal funds . . . since the law forbids the treatment of individuals differently or separately because of their race, color, or national origin.<sup>42</sup>

Sobeloff recognized that the act of filing a statement of assurance did not guarantee compliance and wondered when the HEW carrot of federal funds through Medicare would have its hoped-for effect. In the meantime, he concluded, "it would be fatuous for courts to abstain where the right to relief has been abundantly proved."<sup>43</sup>

## CONCLUSION

Discrimination existed in overt patterns in hospitals throughout the North and South until the mid-1960s. These discriminatory policies and practices barred Black professionals from the medical staffs of hospitals and patients from beds and services, and they denied Black students access to nurse and residency training programs. While actions taken by Congress and the federal government helped eliminate overt racial discrimination in hospital staff privileging, patient admissions, and education programs, without strong court rulings these advances would have fallen short of their intended outcomes.

The significance of the *Simkins v Moses H. Cone Memorial Hospital* case is demonstrated by the US Court of Appeals Fourth Circuit's referring to this decision in nearly every hospital racial discrimination case that followed for the next 2 decades. It both laid the foundation for hospital integration under the Hill-Burton program and provided legal justification for Title VI of the 1964 Civil Rights Act and the Medicare hospital certification program. The Medicare hospital racial integration guidelines that now applied to every hospital that participated in this federal program were challenged in *Cypress v Newport News Hospital Association*, in part because their impact was so pervasive in most southern institutions. Again, the Fourth Circuit Court ruled not only that all qualified physicians should be granted staff privileges, but all patients should be assigned a bed on the basis of their medical and surgical needs, not the color of their skin. ■

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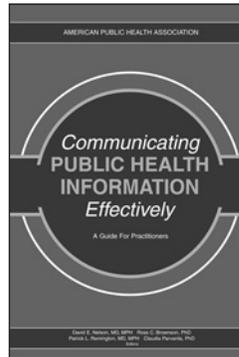
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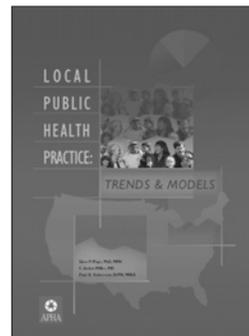
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LP01J7

# Popularizing the Toothbrush

Elizabeth Fee and Theodore M. Brown

## TOOTH DECAY IN EUROPE

and America is believed to have increased dramatically during the 19th century as a result of the growing general availability of refined flour and sugar in industrially processed foods. By the end of the century, surveys showed that between 90% and 95% of all children had untreated decaying teeth.<sup>1</sup> Most children saw a dentist—if at all—only for emergency extractions. In 1910, local dentists examined 447 schoolchildren in Elmira, NY, and reported that only 22 of the children had teeth “in perfect condition.”<sup>2</sup> The other children collectively had 2063 cavities and 617 “teeth and roots needing extraction.” Similar results were being reported from other towns and cities.

Between 1910 and 1916, philanthropists built and endowed the first free and reduced-fee clinics for children and established the first schools for dental hygienists in Rochester, NY, Bridgeport, Conn, and Boston, Mass. By the 1920s, almost all American cities had free or reduced-fee clinics, and by 1950, such clinics were providing almost half of all oral health services delivered to children. Members of local dental associations staffed some clinics on a volunteer basis together with young dental school graduates seeking clinical experience. During the Great Depression, federal funds helped local and state governments to hire unemployed dentists.



**“Here we are coming to clean our teeth, clean our teeth, clean our teeth/ Here we are coming to clean our teeth; and we do it night and morning.” *Toothbrush Drill in New York City*, photographer unknown, circa 1912–1913.**

**Source.** Prints and Photographs Collection, History of Medicine Division, National Library of Medicine, Bethesda, Md.

The first dental hygienists entered the schools to clean children’s teeth and teach them how to use toothbrushes.<sup>3</sup> Some cities provided each child with a free toothbrush and tooth powder, while others sold them at 2 or 3 cents each. As in England, where toothbrushes were provided to all servicemen during World War I, this helped establish and extend the use of the toothbrush in working-class families.<sup>4</sup> American schools also adopted the “toothbrush clubs” and “toothbrush drills” begun in England.<sup>5</sup> This

image, from a New York school, shows children demonstrating their newly acquired skills of toothbrushing. ■

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# An Address on Tooth Culture

Excerpted from "An address on tooth culture," *The Lancet*. 1892;2:6–10.



**Sir James Crichton-Browne, MD, LLD,**  
**by Spy, a pseudonym of the caricaturist Leslie Ward.**  
**Source.** Prints and Photographs Collection, History of Medicine Division,  
 National Library of Medicine, Bethesda, Md.

[S]INCE I READ THE PAPER OF Mr. J. Smith Turner on the Condition of the Teeth of School Children, communicated to the Hygienic Congress in London, I have realised the importance of the inquiry which he described and have sought further information bearing on it. . . . [I]t is surely startling to find that amongst 5249 children under twelve years of age, there were only 485 with normal perfect dentures—that is to say, made up of sound teeth requiring neither filling nor extraction, that only 26 percent of infants at five years of age have teeth free from caries and that every 1000 children at twelve years of age have amongst them 2543 teeth affected by caries. . . . The fact that 10 000 000 of artificial teeth are used in this country annually, although, of course, only a small proportion of the population can procure these articles of luxury, brings home to us the truth that dental mortality is heavy in these days and that the gaps in dental circles that require fillings must be big and numerous. . . .

I wish to confine what I have to say this afternoon to caries, the most ruinous of dental maladies, not only in childhood, but at every epoch of life. . . . [I]t can be scarcely necessary that I should rehearse to you the evidence that has been adduced to prove that it is now far more prevalent in this country than it has ever hitherto been and that its ravages are more widespread

and serious, in the present than in any former generation, about the dental history of which we have records. . . . It is impossible to believe that the British Empire would have become what it is to-day if amongst those hardy Norsemen who pushed up their keels upon the shore at Ebbsfleet and entered upon the making of England there had been only one sound set of teeth in every ten, or if amongst our ancestors, who have extended our dominions by land and sea and won for us our civil and religious liberties by struggles in which personal vigour and endurance counted for more than they do in the highly scientific and explosive warfare of modern times, there had been all but universal rottenness of the teeth before adolescence. Depend upon it that in the England of the past the teeth were not as frail or troublesome as they are to-day. . . . I am not going to argue that sound teeth are the passports to power, or that biting and grinding capacity have determined the course of history, but this I will maintain, that no nation has ever climbed to pre-eminence on carious teeth, or can retain pre-eminence when its teeth are no more and that it behoves a conquering people jealously to look to its teeth and to keep them, not less than its weapons, bright and sharp. . . .

When we inquire into the cause of the greatly increased prevalence of dental caries in

modern times we at once perceive that it is an instance of these imperfect adjustments which we often see in living beings in their passage from a natural to an artificial and from an artificial to a more artificial condition of existence. . . . The resources of civilization are more ample, nimble, and varied than those of dentition and so it has come about that the teeth have not been modified in accordance with the altered habits of life of modern times, and especially of the nineteenth century, and have not yet been adequately protected by specially devised safeguards. But in examining into the causes of the increase of dental decay which we see around us, we can go beyond a mere general statement of this kind and indicate, I believe, some of the specific conditions of modern life which are mainly responsible for it. . . .

In the first place, then, it seems to me that the greater prevalence of dental caries in these days is probably in some measure dependent on the softness and pulpiness of the food on which we for the most part feed. Hardness and toughness of food—and the food of savage and semi-civilised races is generally hard and tough—involve vigorous mastication and vigorous mastication involves a vigorous use of the teeth in their proper function and a copious flow of saliva and a copious flow of saliva involves cleansing of the teeth and gums, to which the active movements of the lips, tongue, and cheeks during mastication largely contribute. But the softness and pulpiness of food—and the food of all civilised races tends to become more and more soft and pulpy—means comparatively little mastication and use of the teeth

and little mastication means a diminished flow of saliva, for the far-fetched condiments of refined cookery do not stimulate the salivary glands to anything like the same extent that ordinary sapid substances with energetic masticatory movements do and a diminished flow of saliva means diminished cleansing of the teeth which are at the same time imperfectly scrubbed by the feeble movement of the parts engaged in mastication, and so it comes about that when the food is soft and pulpy particles of it lodge in and about the teeth and gums, to an extent that is impossible where it is hard and tough and afford a nidus for those bacterial growths which alike by the decomposition they set up and their direct attacks are so inimical to the integrity of the teeth. . . .

In the second place, I would suggest to you as a specific cause of increase of dental caries a change that has taken place in a food stuff of a particular kind and of primary importance—I mean bread, the staff of life,—from which in the progress of civilisation the coarse elements—and the coarse elements consist of the outer husks of the grains of which it is composed—have been eliminated. In as far as our own country at any rate is concerned, this is essentially an age of white bread and fine flour and it is an age therefore in which we are no longer partaking to anything like the same amount that our ancestors did of the bran or husky parts of the wheat and so are deprived to a large degree of a chemical element which they contain—namely, fluorine. . . . Analysis has proved that the enamel of the teeth contains more fluorine, in the form of fluoride of calcium, than any other part of the body and fluorine

might, indeed, be regarded as the characteristic chemical constituent of this structure, the hardest of all animal tissue. . . . If, in our dislike to grittiness, which has run parallel to our addiction to soft and succulent food and in our preference for the white and fine flour, we have cut out the main source of supply of fluorine to our systems, it is not difficult to understand how we may have thereby incurred comparatively feeble and unprotected teeth, with diminished power of resistance to adverse influences and peculiarly liable to decay. . . .

In the third place I would name to you, as a cause of increased dental decay in our population, the high nervous tension of our time and the impaired nutrition which that high tension frequently entails. . . . [T]here are now [also] vast numbers of human beings, the offspring of neurotic or neurasthenic parents, sent “into this breathing world,” “deformed, unfinished,” and “scarce half made up,” whose teeth are delicate and destined to premature decay. The gastro-intestinal mucous membrane of the embryo from which the pulps and sacs of the teeth originate may in such cases be supposed to have been wanting in formative energy, or the trophic influence from nerve centres which is exerted, if not during papillary and follicular, certainly throughout the saccular and eruptive stages of dentition, may be presumed to have been defective. It is to be remembered that as early as the fourteenth week of embryonic life, when the membrane of the dental groove with its adherent follicles and their pulps are stripped off, there may be seen dental nerves running along under the follicles and dis-

tributing twigs to each of them; it is certain that from this time till the completion of dentition at the twentieth year the development of the teeth is more or less under nervous control. It is not to be expected, I think, that robust teeth will grow and come forth in due order in children who are kept in a state of nervous excitement or overstrain. While I am quite satisfied that inherited tendencies are more potent than personal experiences in inducing the dental debility which we encounter in nervous children, I still cannot acquit our modern system of education, with the over-pressure into which it so often runs, of some share in its causation, directly through interference with the growth and eruption of the teeth, as well as indirectly through interference with digestion and secretion and the consequent establishment in the mouth of conditions favourable to dental caries. . . .

In the fourth place, I would mention as a possible cause of the increased prevalence of dental caries amongst us the growing aggregation of our population in the large towns, for this aggregation entails for old and young higher nervous tension than country life, a greater liability to anemia and a low standard of health, and also to several zymotic and constitutional diseases, which not less than general reduction of health and nervous exhaustion leave their stamp on the teeth in impaired nutrition. But more than this, the conditions of town life conduce especially to those forms of dental failure which depend on bacterial onslaughts. Wherever human population is thick on the ground, the bacterial population is thick in the air, and in our crowded cities we have a



# Sir James Crichton-Browne

## Victorian Psychiatrist and Public Health Reformer

### JAMES CRICHTON-BROWNE

was one of the most famous and respected physicians in late-19th- and early-20th-century Great Britain. He was born on November 29, 1840, in Edinburgh, Scotland to a distinguished medical family. His father, Dr William Alexander Francis Browne, a pioneer in the humane treatment of the insane, was one of the first “medical commissioners in lunacy” in Scotland. His mother, Magdalene Howden Balfour, was the grand-niece of the famous geologist James Hutton and the sister of 4 brothers who became distinguished physicians.<sup>1(p295)</sup>

Crichton-Browne graduated in medicine from Edinburgh in 1862. His early interest in psychiatry was evident in his third-year dissertation on “The Psychological Diseases of Early Life” and his MD thesis on “Hallucinations.” He first served as assistant medical officer at the Devon, Derby, and Warwick county asylums and as medical superintendent of the Newcastle-upon-Tyne city asylum. From 1866 to 1875, he was medical director of the West Riding Asylum at Wakefield, and he made Wakefield famous as a model asylum and as a center for research on nervous and mental diseases.<sup>2</sup> There he established the first laboratory in neuropathology in Great Britain and in 1871 began the pioneering *West Riding Lunatic Asylum Medical Reports*.<sup>3</sup> In 1878, along

with several other outstanding neurologists, he founded *Brain*, a journal dedicated to neurological and neuropsychiatric research.

In 1875, Crichton-Browne was appointed lord chancellor’s visitor in lunacy, a post he would hold for 47 years. In that position, he vigorously promoted the needs of the mentally afflicted in Great Britain, both those who were institutionalized and those who were not. He became a major figure in London social and public life and a leading spokesman on science and medicine. In 1878 he was elected president of the Medico-Psychological Association and in 1883 fellow of the Royal Society, his nomination for the latter being seconded by Charles Darwin. In 1886, he was knighted by Queen Victoria.

Crichton-Browne was regarded as an authority on all aspects of medicine, public health, and social reform.<sup>1(p298–299)</sup> He expressed his influential views in a prolific series of papers, addresses, reports, and letters to the press. He supported the campaign for the open-air treatment of tuberculosis, the hygienic control of venereal disease, and the reform of housing for the working classes as the best means to improve their physical and mental health.<sup>4</sup> It was in this spirit of reform that in 1898 he took on the rising public health issue of dental hygiene and the need for school-based interventions. Crichton-

Browne’s neuropsychiatric interests, his public health commitments, and his well-honed rhetorical skills are all evident in this excerpt from his oration before the Eastern Counties Branch of the British Dental Association in 1892.

Crichton-Browne died on January 31, 1938, at the age of 97. He was widely honored on his death as “The Last of the Great Victorians.”<sup>1(p294)</sup> ■

*Theodore M. Brown,  
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crowded atmosphere contrasting unfavourably with the pure air of the country and conveying constantly into the mouths of men, women, and children volumes of parasites pathogenetic and non-pathogenetic. The mouth is indeed veritably a menagerie of tame and wild bacteria. . . .

Whether indigenous or of occasional and foreign intrusion, the bacteria which haunt the mouth find there conditions eminently suitable to their rapid multiplication. The mouth is indeed an incubating chamber specially prepared for bacterial cultivation. In it the proper temperature is steadily kept up and the proper degree of moisture and aeration is maintained, while proper nutriment is liberally supplied in particles of food which adhere to the teeth and gums, in the desquamating epithelium, in the sugar resulting from the transformation of starch by the action of ptyalin, and in the substance of the teeth themselves. . . . It is when the enamel is removed that bacterial inroads in the dentine become practicable and removal of the enamel is effected by lactic acid and the peptonising enzyme which other bacilli produce. Miller found in his experiments on artificial decay that as long as the enamel was entire acid had no power to injure the dentine beneath, but wherever the enamel was thin or imperfectly developed the dentine was soon softened by any acid that was present and the canaliculi were then speedily filled with bacteria, which gave rise to irregular corrosion. As a large majority of the bacteria which find their way into the mouth do produce acids, it is evident that conditions that increase the bacterial supply to the mouth must promote the destruction of enamel

and the invasion of the dental tubules, so that the aggregation of our people in towns must tend to the diffusion of dental caries. . . .

[T]he principal causes of the increase of dental caries have, I believe, been summed up in what I have said to you this afternoon, and the practical question that now arises is what can be done to remove these causes or to counteract their effects, to banish from our country a blight that has invaded every household and to secure to our people the boon of sound and serviceable teeth.

I have said that the present state of matters is deplorable. I am sure you will agree with me that it is harrowing to reflect on the pain and sleeplessness and distress that are daily due to dental caries in this country. Beyond these immediate evils accruing from it there are remote consequences which are even more grievous. . . . The boy who can masticate has much better prospect of success and happiness in life than he who can merely munch, and the girl who dares to show her teeth will have more joy in her womanhood than she who has to veil them behind an imperturbable upper lip.

What, then, are the hygienic and prophylactic measures which should be resorted to for the prevention of dental caries and the preservation of sound teeth? The most important, the most hopeful of all of them, are those which you are met to discuss this afternoon, and which have reference to the care of teeth of children during the period of schooling. . . . [D]ental delinquency is only to be efficiently dealt with—on the large scale, at any rate—amongst those of tender years. I would,

perhaps, not be going too far in alleging that if universal, continuous, and skilful supervision and management of the teeth during their development and eruption—that is, up till twenty years of age—could be secured, there would be practically nothing to do to the teeth afterwards. . . .

[I]t is the clear and pressing duty of Government or Parliament to provide that in all public institutions for maintenance or education of the young, whether under public control, as in the case of training ships, reformatories, industrial and workhouse schools, or under management of committees of subscribers, as in the case of orphanages, hospitals and homes the teeth of the children shall be periodically examined by a qualified dentist and everything that is needful done for their preservation. . . .

As regards Board Schools, there would certainly be greater difficulty in introducing compulsory dentistry. There would, no doubt, be resistance by ignorant and stupid parents, and perhaps by a pig-headed society, to any operative procedure enforced to ensure to children the inestimable blessing of sound teeth, just as there is opposition to compulsory vaccination and other beneficent measures of a kind; but, as far as I can see, there could be no objection to compulsory inspection of teeth and it is this, I respectfully submit to you that you ought to aim at and that, were it once fully introduced, would ultimately secure for us nearly all we want. . . . The very existence of such a system would create a public opinion in favour of sound teeth, it would bring home to the people a sense of the value of tooth culture and lead to widespread adoption of domestic precautions

against dental caries, now too much neglected. In so doing it would have advantages beyond those merely relating to the teeth, for you may depend upon it, that the simple ceremonial observance of the morning and evening toothbrush, regularly preformed, exalts self-respect and so has a wholesome effect upon moral character.

A system of compulsory inspection of the teeth of school children and State-aided rectification of defects in them . . . would of course entail a large outlay of money, for I contemplate that the dentists employed in this public service would be adequately remunerated for their labours; but the money would be well spent and would yield a splendid return in the increased comfort, contentment, health and vigour of our people. . . . [S]ure I am that it would be for the ultimate welfare of the country (if so be that adequate tooth culture cannot be otherwise secured) even that the grand piano in some of our London Board Schools should give place for a time to the dentist's chair. Admirable is the grand piano in its way; it is the high altar of popular aesthetics, but Chopin and Wagner ill accord with the groans of toothache. . . .

In conclusion, I would beg very cordially to wish you success in your efforts to secure the protection of the teeth of the young and I exhort you to steady perseverance in these efforts, undaunted by opposition, unruffled by ridicule and undiscouraged by failure, for your cause is a good and reasonable one and it must prevail. You are a wing, an useful and honoured wing, of the great army that is giving unceasing battle to the powers of darkness, disease and death. ■

# Child Health: Reaching the Poor

Adam Wagstaff, DPhil, Flavia Bustreo, MD, MPH, Jennifer Bryce, EdD, Mariam Claeson, MD, MPH, and the WHO–World Bank Child Health and Poverty Working Group

In most countries, rates of mortality and malnutrition among children continue to decline, but large inequalities between poor and better-off children exist, both between and within countries. These inequalities, which appear to be widening, call into question the strategies for child mortality reduction relied upon to date.

We review (1) what is known about the causes of socioeconomic inequalities in child health and where programs aimed at reducing inequalities may be most effectively focused and (2) what is known about the success of *actual* programs in narrowing these inequalities.

We end with lessons learned: the need for better evidence, but most of all for a new approach to improving the health of all children that is evidence based, broad, and multifaceted. (*Am J Public Health*. 2004;94:726–736)

Substantial progress has been and continues to be made in child health. A child born in 1960 in Latin America or the Caribbean had a 105 in 1000 risk of dying before her first birthday; by 1999, this figure had fallen to 30 in 1000.<sup>1</sup> But progress has been uneven. In the statistics on child health, one common theme emerges: poor children lag behind their better-off peers. Mortality among children aged younger than 5 years (under-5 mortality) currently averages 6 per 1000 live births in the industrialized countries but is as high as 91 per 1000 in the developing world.<sup>2</sup> Child health also tends to be worse among the poor *within* countries. In southeast and northeast Brazil, for example, over the period 1987 to 1992, among children in the poorest third of the population the under-5 mortality rate was 6 times that among the richest 10% of children (113 vs 19).<sup>3</sup> In addition, socioeconomic inequalities in child health appear to be widening. Reductions in infant and under-5 mortality have been fastest among the rich countries,<sup>4</sup> and there is growing evidence that rates of child mortality and malnutrition have fallen faster among the better-off.<sup>5–9</sup>

There is broad acceptance that these inequalities are ethically indefensible—they are *inequities*, not simply inequalities<sup>10</sup>—and that programs and policies in the future ought to improve the health of *all* children.<sup>11–14</sup> In this spirit, we review in this article what is known about the causes of socioeconomic inequalities

in child health. These provide the entry points for programs aimed at narrowing child health inequalities. We also review what is known about the success of *actual* programs in narrowing socioeconomic inequalities in child health.

Our search strategy for the review of evidence was as follows. On inequalities in proximate determinants, we aimed to reflect the medical and social scientific literature on (a) the proximate determinants and (b) their socioeconomic distribution. We also aimed to reflect the medical and social scientific literature on (a) the underlying determinants of child health outcomes, (b) their socioeconomic distribution, and (c) the impact and socioeconomic aspects of child health and related programs (e.g., maternal and child health programs, health insurance for children, etc.). We started by pooling our knowledge of these areas, based on research and programmatic work at a variety of institutions. We then undertook targeted searches in Medline, EconLit, and the World Bank's catalog of bank documents and reports (see <http://www-wds.worldbank.org>). We then circulated the document for comment among specialists in child health and equity issues in academia, the World Bank, the World Health Organization, other international agencies, and bilateral donors. This process added to the literature reviewed. We have tried to focus on journal articles in peer-reviewed journals. However, much of the literature on programs

and program evaluation has been produced by agencies such as development banks, and we decided that excluding this material would significantly limit the depth and scope of the paper. Where possible, we have tried to cite only documents in the public domain and with a reference number (which typically implies an element of peer review and quality control).

## THE CAUSES OF CHILD HEALTH INEQUALITIES: A FIRST PASS

It has been estimated that more than half of global under-5 deaths are attributable to a few conditions, namely pneumonia, diarrhea, malaria, measles, and HIV/AIDS.<sup>15</sup> Malnutrition is associated with almost 60% of these deaths. These conditions disproportionately affect the poor.<sup>16–18</sup> This begs the question: what generates this distribution of cause-specific deaths? The distinction by Mosley and Chen<sup>19</sup> between “proximate” and “underlying” determinants of health provides a useful organizing framework for addressing this issue. The former affect child health directly (e.g., feeding practices, preventive activities, care during pregnancy and childbirth), while the latter do so only indirectly through their effect on the proximate determinants (e.g., mother's knowledge, household income, access to health facilities). A good deal is now known about the proximate determinants of child health—the behaviors, preventive practices, and interventions that can improve the health of and reduce deaths among children. Evidence is also starting to emerge about the socioeconomic distribution of these determinants. Together, these 2 literatures provide the explanation—at one level—for the existence of socioeconomic inequalities in child health.

### Preventive Activities

Low birthweight is linked to malnutrition of the mother before and during pregnancy,

and micronutrient deficiencies in mothers increase morbidity and mortality among young children.<sup>20–24</sup> A malnourished child is less able to fight infections, and malnutrition is a contributory cause in at least one third of under-5 deaths.<sup>15</sup> Exclusive breastfeeding from birth through the first 6 months provides required nutrients and reduces infant mortality from infectious diseases and malnutrition.<sup>25–29</sup> Its protective effect is especially pronounced among the poor.<sup>26</sup> Nutrient intake from complementary foods becomes important after the sixth month.<sup>30,31</sup>

In all aspects of nutrition, the poor tend to be worse off. Maternal nutritional status is significantly worse in poor countries, and among the poor within countries.<sup>5</sup> Child malnutrition tends to be more common among the poor than among the better-off.<sup>32,33</sup> Energy intake from complementary food among infants also displays a socioeconomic gradient,<sup>34</sup> and the consumption of iodized salt is lower in poorer regions.<sup>2</sup> The only feeding pattern that has a gradient that is favorable to the poor in the developing world—but not in industrialized countries<sup>35–37</sup>—is breastfeeding, which decreases with socioeconomic status.<sup>38</sup>

Hygiene, the use of safe water, and the immediate environment where the child lives, including indoor air pollution, are also important proximate determinants of child health. The safe disposal of feces and hand washing after defecation and before food preparation can protect children from diarrhea<sup>39</sup> and other communicable diseases, as can the use of safe drinking water.<sup>40</sup> Indoor air pollution in family homes is produced by burning coal or biomass fuels (wood, dung, fiber residues) for cooking and heating, in combination with inadequate ventilation. Prolonged exposure to indoor air pollutants increases the risk of pneumonia in children<sup>41–43</sup> and of low birth-weight.<sup>44</sup> As with nutrition and feeding, the poor tend to be disadvantaged—hand washing and the appropriate disposal of excreta are more common in better-off households,<sup>34</sup> and the poor, who rely disproportionately on agricultural residues and animal dung as sources of fuel, are most at risk of exposure to indoor air pollution.<sup>45</sup>

A number of other key preventive activities are also known to improve child health. Antenatal care and assistance at birth result in

healthier newborns and can help foster healthy feeding practices of newborns, young children, and mothers. Birth spacing can improve the survival prospects of subsequent children.<sup>46</sup> Measles immunization has been shown to have beneficial effects that go well beyond the prevention of measles mortality,<sup>47–49</sup> and it has especially pronounced effects among poor children.<sup>50</sup> Regular use of insecticide-treated nets for the prevention of malaria can reduce illness and deaths from malaria in geographic areas where the disease is common.<sup>51–55</sup> Each of these preventive activities tends to display a socioeconomic gradient: poorer countries typically have lower rates of antenatal care use, attended deliveries, contraceptive use, and immunization<sup>2</sup>; within countries, too, gradients are evident between the poor and better-off.<sup>5,56</sup>

### Care During Illness

Some childhood illnesses can be managed at home. Correct home management involves a number of important family practices. Some of these have been investigated thoroughly and shown to be effective, such as giving increased fluids and continuing to feed a child with diarrhea<sup>57</sup> and providing the appropriate treatment for pneumonia and malaria. Rates of oral rehydration therapy (ORT) (increased fluids plus continued feeding) for children with diarrhea tend to be somewhat lower in poorer countries,<sup>2</sup> but within countries they do not vary markedly with wealth.<sup>5</sup> By contrast, receipt of an appropriate antibiotic by children with probable pneumonia does display a socioeconomic gradient, as does the correct use of antimalarial treatment.<sup>58</sup>

Some childhood illnesses require professional care. Poor or delayed care-seeking has been identified as a contributor in up to 70% of child deaths.<sup>59</sup> The decision to take a sick child to a knowledgeable provider is associated with socioeconomic status.<sup>5,60</sup> For caregivers who take the child to a provider, additional practices are involved in compliance with the treatment and advice they are given about how to care for the child. For severely ill children, this advice can include referral to hospital. Evidence indicates the existence of a link between treatment compliance and child health outcomes.<sup>61</sup> Unnecessary illness can

arise from incomplete treatment, therapy failure, drug resistance, and the later misuse of leftover medicines. Compliance with treatment advice and referral is associated with parents' socioeconomic status.<sup>62</sup>

## THE CAUSES OF CHILD HEALTH INEQUALITIES: DIGGING DEEPER

At one level, then, the causes of socioeconomic inequalities in child health are clear. A limited number of proximate determinants have been demonstrated to affect the health of children directly. These behaviors, preventive practices, and interventions that can improve child health and reduce child deaths are unequally distributed across socioeconomic groups. But the Mosley-Chen framework prompts the obvious next question: why do these inequalities in the proximate determinants of child health arise and persist? Why, for example, are children in the richest quintile in India 3 times more likely to be immunized despite the existence of a free-of-charge and ostensibly universal government immunization program?<sup>63</sup> Digging deeper into the causes of child health inequalities is crucial to identifying the failures of policies to date and to devising successful policies to combat inequalities in child health for the future.

The fact that most of the key proximate determinants of child health are worse among the poor does not necessarily mean that it is low income that is the *cause* of these inequalities. The poor are disadvantaged compared with the better-off on a number of underlying determinants of child health, as well as having less income. The literature reviewed in this section covers a broad range of studies: some use multiple regression methods to parcel out the different effects of the various underlying determinants of child health; some document their inequalities across socioeconomic groups; together, they provide a picture of the underlying causes of socioeconomic inequalities in child health.

### Financial Barriers

*Income.* Measures of child health tend to improve with income, at both the country level<sup>4,11,64,65</sup> and the child level.<sup>65–73</sup> Most proximate determinants tend to improve with higher income, including adult energy in-

take<sup>74,75</sup>; the likelihood of a pregnant woman receiving antenatal care<sup>76,77</sup>; the timing of antenatal consultations<sup>77,78</sup>; the likelihood of a delivery taking place away from home<sup>72,79,80</sup>; the likelihood of a child being immunized,<sup>81,82</sup> sleeping under an impregnated bednet,<sup>56</sup> or being given ORT<sup>83</sup>; and the likelihood of a caregiver seeking care for a child with fever.<sup>84</sup>

It is not just a household's total income that matters but also the degree of the woman's control over its use. Women who exert relatively little control over household financial resources are less likely to receive antenatal care, have fewer antenatal visits, and are less likely to have visits in the first trimester of pregnancy.<sup>85</sup> It seems likely—though the evidence is weak—that poorer women exert less control over household resources than better-off women.

*Price.* It is known that a higher monetary price for health care tends to reduce, or at least delay, health service use, especially among the poor, unless accompanied by improvements in service quality.<sup>86,87</sup> Cost also tends to be a factor in determining the demand for other proximate determinants of child health: cost influences the use of bednets among poor households,<sup>88</sup> and higher food prices have negative impacts on child survival and malnutrition,<sup>73,89,90</sup> with the poor being particularly vulnerable.<sup>73,74</sup>

### Health Care Provision

There are several key steps to ensuring accessible and good-quality health services.<sup>91–95</sup> On each step of this ladder, the poor are disadvantaged.

*Geographic accessibility.* An important dimension of geographic accessibility is travel time. This depends on the distance households have to travel, and also on the transportation system, the road infrastructure, climate, and geography. Both distance and travel time have a significant impact on utilization and health outcomes.<sup>73,77,89,90,96–98</sup> The poor tend to have to travel further to get to health facilities and—owing in part to the extra distance but also the difficulty of transportation—longer.<sup>99,100</sup>

*Availability of human and material resources.* Services may be geographically accessible, but essential inputs, such as drugs, vaccines, contraceptives, micronutrients, or trained

staff, may be unavailable or in short supply. Child mortality and malnutrition have been found to be sensitive to the availability of drugs in local facilities.<sup>73,89</sup> This reflects in part the fact that use of services (e.g., antenatal care and vaccinations) is higher in households living in areas where local facilities are well stocked with essential drugs and staff.<sup>73,89,97</sup> But it also reflects the greater impact that contacts in such facilities have on health outcomes. Facilities serving the poor are less likely to be well stocked with drugs and to be properly staffed.<sup>73,89,101</sup>

*Organizational quality.* The way health services are organized (hours of operation, waiting time, gender of providers, lack of courtesy, required under-the-table payments) are cited in qualitative studies as determinants of service use.<sup>102</sup> Health facilities have been criticized by poor people for their long waiting times and rude staff,<sup>101</sup> but evidence is scant on whether facilities of a particular type that serve poor people are systematically worse in their organizational quality than those serving better-off people.

*Relevance of services.* Child mortality and malnutrition have been found to be sensitive to the availability of child health services (e.g., immunization programs, child birth facilities, and growth monitoring) in local facilities.<sup>73,89</sup> Studies have reported fewer child-specific services being offered by facilities serving poor rural areas than by facilities serving better-off urban areas.<sup>73,89</sup>

*Timeliness of services.* Certain key health services—such as emergency obstetric care or referral services for severely sick children, and also immunization and other routine preventive services—must be delivered in a timely manner. Timeliness of service use tends to be worse among the poor, but these inequalities reflect both differences in care-seeking behaviors on the part of households and differences in provider behavior.

*Technical quality.* The technical quality of care—measured, for example, by the quality of case management—influences the size of health improvement consequent upon a particular health service contact. It can also influence utilization decisions by caretakers. The quality of case management of childhood illness by health professionals varies considerably, and is often very low.<sup>103–105</sup> In part, this

reflects lack of availability of drugs and human resources. Are the poor reliant on poor-quality facilities? Drugs and human resources are certainly less available in facilities serving the poor. The poor are also heavily reliant in some countries on informal private sector providers.<sup>5,106</sup> These are known to provide poor-quality care—including inappropriate antibiotic use for diarrhea and noncomplicated acute respiratory infection, and inadequate malaria prescription.<sup>107–111</sup> However, no evidence is available on whether quality in the public sector is any better.

### Maternal Education

In many countries, the mother's education has been found to increase child survival<sup>66–68,71,72,79,112–116</sup> and to decrease child malnutrition,<sup>68,116,117</sup> even when other determinants are held constant. There are, however, studies that have found weak or nonexistent effects for one indicator or both.<sup>68,70,89,90,116–118</sup> Most proximate determinants usually increase with higher levels of maternal education; these include complementary food nutrient intake among infants<sup>34</sup>; good hygiene, including hand washing and appropriate disposal of excreta<sup>34</sup>; the likelihood of receiving antenatal care, and of choosing formal care in preference to traditional care; the timing of antenatal consultations<sup>77,78</sup>; the likelihood of a baby being delivered away from home,<sup>72,79,80</sup> or by a trained person irrespective of where the birth occurs<sup>79,80,119</sup>; the use of well-baby clinics<sup>34</sup>; the likelihood of a child being immunized<sup>81,82,119</sup>; the ORT use<sup>83,120</sup>; and the likelihood of a caregiver seeking care for a child with fever.<sup>84</sup>

The link between maternal education and child health, and the tendency for poorer women to be less well educated, is one of the other key explanations of why poorer children die earlier and are less well nourished. The socioeconomic inequalities in maternal education are large both across countries<sup>2</sup> and within them.<sup>121</sup> In many countries, the gap between the poor and the better-off is larger among women,<sup>122</sup> whose knowledge is often most important for child health.

### Water, Sanitation, and the Home Environment

When other underlying determinants of child health are held constant, improved

drinking water sources (quality, but especially quantity) and adequate sanitation are often typically found to lead to better child health outcomes.<sup>66,67,89,90,116,123–126</sup> This is hardly surprising, since hygienic behaviors are easier when safe water and a flush toilet or latrine are available in the house. Socioeconomic inequalities in water and sanitation are highly visible between countries and within them.<sup>2,10</sup>

### Other Underlying Determinants and Their Inequalities

A variety of social norms and practices influence women's access to resources, both inside the household (e.g., food, water, time) and in the community (e.g., land, extension services, credit). They also influence their decisionmaking power in the household. These norms influence their capacity to seek health care and to devote time and energy to child care.<sup>127</sup> Community infrastructure also matters. The likelihood of households having good drinking water and good sanitation is greater if pipes and sewerage systems are in place in the local community. Furthermore, good sanitation in the community reinforces the beneficial effects on nutritional status of good sanitation at the household level.<sup>128</sup> Electricity has been linked to overall child mortality.<sup>129–131</sup> In each of these respects, the poor tend to be disadvantaged. In poor communities, for example, attitudes toward women tend to be less favorable to good health outcomes.<sup>127</sup>

### WHAT CAN PROGRAMS DO TO NARROW SOCIOECONOMIC INEQUALITIES IN CHILD HEALTH?

Digging below the proximate causes of child health reveals how, ultimately, socioeconomic inequalities in child health can be traced back to a complex web of socioeconomic inequalities in the underlying determinants of child health. The exercise also provides clear pointers to help understand the failure of policies to date, and to help design more promising policies.

#### Lowering Financial Barriers for the Poor

*Raising the income of the poor.* As has been seen, income has pervasive effects on child health, operating through a number of key proximate determinants and interacting with other underlying determinants, such as water

and sanitation. Macroeconomic and microeconomic policies that succeed in raising average income—without having adverse effects on its distribution—are thus likely to have payoffs in terms of improved child health outcomes among the poor.

The same is true of policies aimed at improving the living standards of the poor. Social protection programs can also act as anti-poverty programs, as shown by South Africa's pension program. The program was initially designed to provide a relatively generous safety net for Whites who reached retirement age without an adequate employment-based pension. By the end of 1993, the pension had become an important source of income for non-Whites, and it has been found to have improved the health not only of pension recipients but of other members of households where resources are pooled.<sup>132,133</sup> Among Black children aged younger than 5 years, the pension is estimated to have led to an 8-cm increase in height.

Microcredit programs have also been discussed as ways of improving maternal and child health. While it is clear that at least some of these programs have indeed reached poor women, doubts have been expressed about the alleged beneficial effects of participation on the use of contraceptives and maternal health services; studies have failed, it is argued, to control for self-selection into the microcredit program and nonrandomness in their placement.<sup>134</sup>

*Making transfers contingent on participation in health-promoting activities.* In Honduras, a family allowance program known as *Programa de Asignación Familiar* (PRAF) [Family Allowance Program] provides a cash payment to poor households with children or pregnant women that is contingent on continued prenatal checkups, growth monitoring, and vaccinations.<sup>135</sup> The *Programa de Educación, Salud y Alimentación* (PROGRESA) [the Education, Health, and Nutrition Program] in Mexico and the social protection network in Nicaragua are similar in design.<sup>135–137</sup> Evidence suggests that these 3 programs have all been well targeted on the poor.<sup>135</sup> PROGRESA has also been found to have significantly increased use of public health clinics for preventive care, including prenatal care and child nutrition monitoring, with no offsetting reduction in the use

of private providers. It is also estimated to have caused a 12% reduction in the incidence of illness among under-5 children<sup>138</sup> and an increase of about one sixth in mean growth per year among children aged 12 to 36 months who received multimicronutrient food supplements as well as the conditional cash transfers.<sup>137</sup>

*Making health services and other health determinants less expensive.* The cost of health care can be lowered through a variety of means, including health insurance, health cards, fee waivers, and vouchers. Whether public,<sup>139,140</sup> private,<sup>141</sup> or community based,<sup>142</sup> health insurance often increases the use of health services. In some studies, use by the poor has been found to be particularly sensitive to coverage by insurance and other schemes that reduce the price of health care. For example, Egypt's School Health Insurance Program appears to have had a marked impact on the probability of a visit to a formal provider among children in the poorest quintile.<sup>140</sup> Indonesia's health card scheme also appears to have had an especially pronounced impact on use among the poor.<sup>143</sup>

Two factors need to be borne in mind. First, it is important to ensure that providers get reimbursed for treating those whose fees have been reduced, which often has not been the case. For example, in the early years of the Seguro Materno Infantil programs in Bolivia and Peru, providers were not fully reimbursed when delivering services covered by insurance.<sup>144</sup> Second, it is important to devise ways to ensure that the poor, and especially the very poor, are covered. The poor are typically left uncovered by social insurance schemes,<sup>6,145</sup> have insufficient resources to purchase private insurance,<sup>141</sup> and are often uncovered even by community-financing schemes,<sup>94,142,146,147</sup> and fee waivers rarely exempt the poor.<sup>6,87,148</sup> There are, however, some encouraging trends and examples. In Colombia, although social insurance coverage is still higher among the better-off, the poor were the major beneficiaries of the expansion in coverage during the 1990s.<sup>145</sup> Similarly, the health card scheme operating in Indonesia, which was intended to be targeted toward the poor, has been so in practice.<sup>143</sup>

Policies to reduce the prices of medicines, food, and other proximate determinants of

child health have also had beneficial effects. For some drugs, governments may require the assistance of the global community to help lower the price. In many cases, however, countries may be able to achieve a good deal by themselves, through, for example, deregulation.<sup>6</sup> In some cases, it may be feasible to subsidize the price of drugs for the poor. Strategies such as the social marketing of bednets can be adapted to include well-targeted subsidies, as in the Tanzania example. In nutrition, a variety of schemes have been employed to reduce the cost of food—either for the population as a whole or the poor in particular. Examples include food stamps, food subsidies, and school feeding programs.<sup>149</sup> In Guatemala City, for instance, the Hogares Comunitario program provides incentives for mothers to improve feeding practices.<sup>150</sup>

### Improving Health Provision for the Poor

*Making services more accessible for the poor.* Accessibility can be improved in a number of ways. One way is to reduce travel time to existing health facilities. Evidence on the impact of road improvement projects on health care use and health outcomes is limited, and the evidence available to date is not clear-cut.<sup>151,152</sup> Another strategy is to expand the coverage of facilities by building new ones, making use of community-based service delivery, or using outreach from existing facilities. This has been a common theme in a number of maternal and child health programs. In the Matlab Maternal Child Health and Family Planning project in Bangladesh, services were delivered in a set of intervention districts through a mixture of government facilities and mobile workers, supported by fieldworkers from nongovernmental organizations (NGOs).<sup>153</sup> Over the period 1982 to 1996, child mortality fell by over 40% in both the intervention and nonintervention districts. The biggest percentage reduction in the nonintervention districts was in the richest group, while in the program districts the largest reductions were among the poorest group.<sup>154</sup> The use of outreach was also a key feature of the Bamako Initiative in West Africa.<sup>92</sup> In both Benin and Guinea, evidence suggests that the use of outreach led to significantly higher levels of immunization coverage, although the socioeconomic distribution it is not known.<sup>93</sup>

Several Latin American countries—notably Bolivia, Brazil, Mexico, and Peru—have expanded coverage of basic health care to their poor populations on a systematic basis and aimed to improve the relevance and technical quality of care.<sup>155</sup> Rather than extending existing delivery modalities, these programs have involved contracting with community agents of one kind or another. Results in Ceará, in the northeast of Brazil, indicate that substantial improvements occurred in average levels of service use and outcomes following the program's introduction. Service use, for example vaccination coverage, weighing, and ORT use, increased fastest among the poor.<sup>156,157</sup> Health outcomes, such as diarrhea, stunting, and underweight, improved in all populations, although they improved faster among the better-off.

The use of contractors (including NGOs) has been a feature of other countries' attempts to expand access. In many cases, payment has been linked to results, rather than to contacts. Performance-based contracts with NGOs have been used to deliver community-based nutrition services (growth monitoring, nutrition and education sessions, referral to health facilities of unvaccinated children and pregnant women, and food supplementation) in Senegal and Madagascar.<sup>158</sup> In areas covered by both projects, lower rates of malnutrition were found among children who had benefited from the project compared with those who had not. In Madagascar, poorest children with severe malnutrition gained the greatest benefit from the project. Results from a recent experiment in Cambodia, in which "contracted-out" providers and "contracted-in" providers were compared with traditional Ministry of Health providers, suggest that there may be benefits from contracting, especially for the poor.<sup>159</sup> However, since government spending per person was substantially higher in contracting districts than in Ministry of Health districts, it is not clear whether the improvement overall and the lower inequality was due to the contracting arrangements or to the higher resources available.

*Increasing the availability of human and material resources in facilities serving the poor.* The Bamako Initiative in Guinea and Benin is one example of a systematic attempt to increase the availability of drugs at first-level facilities.<sup>91</sup>

This involved a community-based cost-sharing exercise, the retention of revenues locally to maintain drug supplies, and an essential drug policy focused on generics. The strategy led to substantial increases in immunization coverage and use of antenatal care, although it is not known whether impacts were similar for all socioeconomic groups.<sup>160</sup> Some concerns have been expressed that cost-sharing arrangements in the Bamako Initiative may deter use by the poor. However, the evidence seems to be inconclusive, with one study suggesting that the poor were not deterred more than the better-off from seeking health care.<sup>160</sup> A way of minimizing any negative effects on use among the poor is to couple cost-sharing with a solidarity community tax. In Niger, where this approach was tried, use among the poor actually increased when the revenues from both the fees and the tax were used to purchase drugs for facilities.<sup>161</sup>

Social Investment Funds (SIFs) have also been used to increase resources—infrastructure, stocks of equipment, medicines, vehicles—in health facilities in poor areas.<sup>162–164</sup> Through the use of targeting mechanisms, SIFs can, in principle at least, be concentrated on poorer areas. In practice, health investments in the Nicaragua SIF were well targeted, while those in the Bolivian SIF were not. However, in Nicaragua no significant impacts on diarrhea prevalence or malnutrition were found for any of the SIF investments. In Bolivia, by contrast, SIF health investments led to significant improvements in antenatal controls and attended deliveries and to a 26% decline in under-5 mortality.<sup>162–164</sup>

Geographic resource-allocation formulas also have the potential to increase the resource endowments of facilities serving the poor. These have provided a means of reducing inequalities in resources between poor and better-off regions in industrialized countries.<sup>165</sup> In the developing world, such formulae have not been widely used, although a scheme was introduced in Mexico in 1998<sup>166</sup> and plans are at an advanced stage in several other countries.<sup>144,167–171</sup> In the absence of such formulae, it is hardly surprising that better-off regions typically receive more public resources than poorer regions.<sup>144,171</sup>

*Increasing technical quality of health care for the poor.* In the 1990s, several countries

mounted national control of diarrheal disease programs aimed at improving case management and promoting the use of ORT and preventive interventions. These programs aimed at universal coverage, and some studies suggest that they have had a sizable impact on mortality.<sup>57,172–175</sup> However, they were not designed to evaluate whether there were similar impacts on the mortality rates of the poorest and the better-off.<sup>57</sup>

A central strategy of these programs is to improve the skills of health staff as a means of improving the technical quality of care in health facilities serving poor children. The Integrated Management of Childhood Illness (IMCI) strategy seeks to improve provider skills, by combining elements of improved treatment for the major killers of children aged younger than 5 years with prevention through assessment of immunization status, improved feeding practices, and protective behaviors.<sup>176–181</sup> The quality of care provided by health workers trained in IMCI has been found to be significantly better than the quality provided by nontrained health workers in several settings<sup>182,183</sup> (Ministry of Health, Bolivia, unpublished data, 1999). No published evidence is yet available on the impact of IMCI on health outcomes, either among the population as a whole or among the poor in particular, since IMCI has yet to be taken to scale. The ability of health systems to effectively implement IMCI and other basic health services is limited without investment in the health system overall.<sup>184</sup> The identified impediments to the successful delivery of quality health services, including IMCI, are high level of staff turnover, inadequate mechanisms and incentives to maintain health worker performance, inadequate drug supply, and inadequate management capacity at the central and district levels (D. Robinson, MD, unpublished data, 2001). These problems are especially pronounced in poorer areas.<sup>185</sup>

### Bringing About Behavior Change

Maternal education has pervasive effects on child health, operating through a number of key proximate determinants and interacting with other underlying determinants, such as water and sanitation. Increasing the educational levels of girls is highly likely, therefore, to have major payoffs in terms of improved

child health outcomes among the poor. But behavior change can be brought about through means other than formal education.

Mild and moderate malnutrition can be eliminated or controlled through relatively simple changes in dietary and food hygiene practices that are targeted by behavior-change strategies.<sup>186</sup> For example, in Accra, informal education was found to mitigate the negative effect of poverty and low maternal schooling on children's nutritional status.<sup>187</sup> In Brazil, the provision of nutrition education and counseling by IMCI-trained health workers resulted in improved knowledge on the part of mothers, better feeding practices, and improved nutritional status of children after 18 months.<sup>188</sup> In peri-urban Mexico City, exclusive breastfeeding practices were improved following home-based peer breastfeeding counseling.<sup>189</sup> What is less clear is how far the nutritional status of poor children can be improved through these means, given that severe malnutrition is more concentrated among the poor than moderate malnutrition.<sup>32</sup>

Hygiene is another area where information, education, and communication interventions have proved effective in changing behavior. Recent reviews of the evidence<sup>190</sup> found that 12 hand-washing interventions in 9 countries achieved a median reduction in diarrhea incidence of 35%, while measures aimed at increasing the safe disposal of feces achieved a median reduction of diarrheal disease of 26%, a median reduction in all-cause child mortality of 55%, and a median reduction in mortality from diarrhea of 65%. There is some evidence that this approach benefits the poor—in Central America, the social marketing of soap resulted in higher reductions in diarrheal incidence rates among poor children.<sup>191</sup>

### Improving Water, Sanitation, and the Home Environment Among the Poor

There is also scope for improving child health through improvements in infrastructure at the household and community levels. A recent study of piped water in India highlights how the impact of piped water on child health varies with income and maternal education.<sup>192</sup> Among poorer children, piped water reduces the incidence of diarrheal disease only among those whose mothers had education above primary level. This high-

lights the importance—especially among poor households—of behavior-change strategies to accompany water infrastructure projects. The above-mentioned SIFs in Bolivia and Nicaragua also included sanitation, and the Bolivia SIF included water projects too.<sup>162–164</sup> In both countries, the sanitation investments were poorly targeted, being disproportionately concentrated in better-off areas, but water projects were well targeted. No significant impacts of either water or sanitation projects on diarrhea were found in Nicaragua, but in Bolivia water investments are estimated to have resulted in a 41% reduction in under-5 mortality. Investments in improving the home environment are also likely to have payoffs. A recent study in Kenya demonstrated that the use of cleaner fuels and improved stoves can reduce the prevalence of acute respiratory infections and conjunctivitis among children younger than 5 years of age.<sup>193</sup>

## CONCLUSIONS

The facts on child health inequalities are sobering. Large inequalities between poor and better-off children exist, both between and within countries. These inequalities appear to be widening rather than narrowing. These data call into question the strategies relied upon to date.

There is, as we have shown, solid knowledge on most of the key proximate determinants of child health. For the most part, poor children fare worse than better-off children. At one level, then, the causes of socioeconomic inequalities in child health are clear. We have also shown how disparities in the proximate determinants of child health are caused by a complex web of socioeconomic inequalities in the *underlying* determinants of child health.

As highlighted in a recent review of child health programs, 2 broad themes emerge from our analysis.<sup>194</sup> The first theme is that households—and in particular caregivers—play a crucial and *dual* role: as “producers” of child health and as “demanders” of health services. Understanding the behavior of caregivers provides the key to modifying caregiver behavior and is thus a crucial process in improving child health outcomes. The education of the caregiver plays a major role, as does the availability of a good water supply and adequate

sanitation facilities. In all of these respects, the poor are disadvantaged. Tackling these disadvantages can help poor households as producers of child health to achieve more from the “inputs” they currently use (e.g., getting a more nutritious diet from the food they already have) and to obtain more “inputs” where necessary (e.g., additional food, insecticide-treated nets, antibiotics, antimalarials). It can also help the poor to make more and better use of health services—for example, to fully immunize their children and to get antenatal care and a safe delivery.

*The second main theme is that providers and health systems matter too.* They matter in part because they influence caregivers’ decisions—inaccessible, poorly stocked facilities with rude and inattentive staff will not be widely used, even by poor people. The delivery strategy—not only strengthening facilities but also building community-based preventive activities and service delivery structures that are properly linked to facilities—is also crucial. The implications of service delivery characteristics for caregivers’ decisions on health care use have not been given enough attention to date. Caregivers have been often seen as passive actors.

The *productivity* of health care providers—the amount of health improvement they confer on a child as result of a contact—is important. The knowledge and skills of providers are clearly necessary but not sufficient. Providers also need to be properly motivated. Incentives matter. In recognition of this, many governments, when expanding coverage to the underserved, have explored alternative contractual arrangements to the more traditional salaried employee model. Getting the right mix of skills, resources, management, accountability, and motivation is a major challenge. It is especially problematic in poorer communities. For example, relying on local communities to finance efforts to staff and stock the facilities serving them is less of an option for poor communities than better-off communities. Some mechanisms of solidarity in health financing between the poor and better-off are needed. Likewise, in designing incentive schemes for providers serving poor communities, it needs to be borne in mind that reaching the poorest is not straightforward. The poorest households may be more

dispersed and less well-informed about the benefits of key child health interventions.

## LOOKING FORWARD

Because the underlying determinants of child health are many, and because the poor are disadvantaged in all, there are *several* pressure points to explore when devising policies to tackle child health inequalities. These can be as diverse as income transfers, micro-credit for poor women, health cards or health insurance for the poor, outreach to poor rural areas, behavior-change projects, quality of services, water and sanitation infrastructure investments, and others. Many of these have been found to have a positive impact on child health outcomes or utilization decisions in specific country settings, and in some cases a larger impact has been found for the poor than the less poor. Some have been found to be inadequately targeted at the poor. Although the evidence base on which to construct programs to reduce socioeconomic disparities in child health could be firmer, enough is known about what makes for a successful set of programs and enough positive examples of actual programs are already available for us to do more and better *now* to reduce rates of mortality and malnutrition among poor children.

But it is not just the large array of possible pressure points. They are potentially *synergistic*, so it makes sense for the approach to be *multifaceted*. Focusing on just one underlying determinant is unlikely to have such a big impact per dollar as tackling several disadvantages simultaneously. It is possible—the evidence is not yet available—that, per dollar of public expenditure, a policymaker could achieve more by, for example, making income transfers contingent on participation in activities aimed at improving child health than by simply making an unconditional income transfer.

Finally, better evidence is needed on how well programs are reaching poor children, and how far they are improving poor children’s health. It is unrealistic to expect every program to analyze the socioeconomic distribution of beneficiaries and evaluate impact for different socioeconomic groups. But more needs to be done. Evidence is also needed on

the influence of *contextual factors* on program targeting and impact, such as the policy environment, the quality of governance, implementation capacity, resources, and the degree to which the system is focused on and responds to results. Many child health programs have narrowed child health inequalities, but they can do better. ■

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## Contributors

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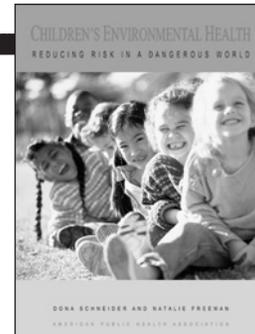
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## Children's Environmental Health

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# John Henryism and Self-Reported Physical Health Among High–Socioeconomic Status African American Men

Vence L. Bonham, Sherrill L. Sellers, and Harold W. Neighbors

We performed a cross-sectional survey of high–socioeconomic status (SES) African American men and their health to examine the relationship between John Henryism (the strong behavioral predisposition to directly confront barriers to upward social mobility) and self-reported physical health status. We found a positive association between John Henryism and better physical health among high-SES African American men. The study of social and behavioral implications of health of men of differing SES is required to develop strategies to improve the health of African American men. (*Am J Public Health*. 2004;94:737–738)

African American men report lower levels of physical health and have higher mortality rates than their non-Black counterparts.<sup>1</sup> One of the causes of this increased risk is exposure to racially based stressors.<sup>2</sup> To better explain these patterns of physical health risks in general, and cardiovascular risk in particular, Sherman James developed the construct of John Henryism. John Henryism is a strong behavioral predisposition to directly confront barriers to upward social mobility.<sup>3</sup> African Americans possessing a high John Henryism orientation believe that just about any obstacle can be overcome through hard work and a strong determination to succeed.

The majority of studies on John Henryism have focused on hypertension.<sup>3–8</sup> This study analyzes the association between John Henryism and self-reported health status in a high–socioeconomic status (SES) group of African

American men. Assessing the relationship of John Henryism to self-reported health status expands the body of knowledge on John Henryism. At present, we do not know enough about whether John Henryism operates primarily on cardiovascular disease or whether it has more pervasive health effects.

## METHODS

The study sample consisted of African American men who were members of a historically Black national fraternal organization drawn from 5 midwestern states. Study design was a cross-sectional survey and included a total of 399 completed interviews. The overall response rate for the survey was 78.7%, with a refusal rate of 8.2%. Response rates did not vary appreciably across the states. Ordinary least squares regression analysis was used to assess the relationship between physical health as measured by the short form health survey (SF-12)<sup>9</sup> and high active coping as measured by the John Henryism scale.<sup>3</sup>

Control variables included age, income, education, and marital status; age and income were continuous measures. Age was measured with the respondent's date of birth, and income was based on a continuous measure of self-reported annual income from all sources. Education was dummy-coded 1 for bachelor's degrees and 0 for graduate degrees; marital status contrasted those who were married with those who had never married or were formerly married. The John Henryism scale was constructed by summing scores on 12 items. Total scores range from a low of 12 to a high of 60. Cronbach  $\alpha$  for internal consistency was .69.

The dependent variable was the physical health component of the SF-12 constructed to have a mean of 50 and standard deviation of 10; higher scores are associated with better physical health.<sup>9</sup>

## RESULTS

Table 1 reports the correlations and descriptive statistics for the sample. Mean age of respondents was 47.6 years, and mean annual household income was \$87 653, indicating a sample well above the national average income; nearly 70% were married. Respondents were highly educated: 56% held masters or doctorate degrees. The mean score on the John Henryism scale was 51.6, and the median score was 51.25, which indicates a modest level of active coping. The mean score for SF-12 physical health subscale was 52.9, indicating a healthy sample. Table 2 presents an ordinary least squares regression model predicting physical health. Older men and those with lower incomes had poor physical health. A trend was found for education and marital status indicating that men who were married and those without postgraduate education scored lower on physical health. Furthermore, there was a trend indicative of a positive association between John Henryism and physical health ( $P=.069$ ) such that respondents with higher levels of John Henryism reported better physical health.

## DISCUSSION

Previous work on race, SES, and health in African Americans has led to different perspectives on the health implications of John Henryism.

**TABLE 1—Correlations Among Measures and Descriptive Statistics**

	Physical Health	Age	Income	Education	Marital Status	John Henryism Score
Physical health	1.00					
Age	-.31***	1.00				
Income	.18***	.076	1.00			
Education	-.051	.35***	.26***	1.00		
Marital status	-.072	.22***	.44***	.22***	1.00	
John Henryism score	.083	.008	.029	.050	.035	1.00
Mean	52.92	47.63	87 652.0	.56	.69	51.63
Standard deviation	6.43	16.2	38 717.5	.50	.46	4.75
N	396	396	359	395	396	389

\* $P < .1$ ; \*\* $P < .05$ ; \*\*\* $P < .01$ .

**TABLE 2—Unstandardized Regression Coefficients**

(SE) Predicting Physical Health	Physical Health
Age	-.096 (.021)†
Income	.000 (.000)†
Education (1 = bachelor's degree)	-1.14 (.682)*
Marital status (1 = married)	-1.32 (.760)*
John Henryism	-.121 (1.00)*
Constant	49.17 (3.61)†
R <sup>2</sup>	.140

\* $P < .1$ ; \*\* $P < .05$ ; \*\*\* $P < .01$ ; † $P < .001$ .

Some studies indicate that John Henryism protects upper-SES African Americans from the negative health effects of race-based stressors, whereas others indicate the opposite.<sup>10–12</sup> This study finds that among high-SES African American men, John Henryism is beneficial for health.

The reasons for the positive health effects of John Henryism remain the subject of conjecture. John Henryism is an individual behavioral predisposition that can pay major dividends for career achievement and material gain.<sup>13</sup> Clearly, the economic and educational success of these men provides them greater access to quality health care. Our data indicate that in the context of high SES, John Henryism is a resource that African American men draw on to contribute to their positive health outcomes. We speculate that John Henryism is conducive to increasing personal responsibility for one's health with the same single-minded determination to succeed. This hypothesis deserves further study.

To develop public health strategies to improve the health of all African American men requires the study of the social and behavioral implications of health of men of differing SES. ■

### About the Authors

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### Contributors

V.L. Bonham was the principal investigator of the project and conceived the study. V.L. Bonham, S.L. Sellers, and H.W. Neighbors each contributed substantially to conceptualization and design of the study and to inter-

pretation of the findings. S.L. Sellers conducted the statistical analyses. H.W. Neighbors provided guidance in the interpretation of the findings. Each author contributed equally to critical revision of the article.

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### Human Participant Protection

This study was approved by the Michigan State University committee on research involving human subjects.

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## Swimmer's Itch: Incidence and Risk Factors

Lois M. Verbrugge, PhD, MPH, Jeanette J. Rainey, MPH, Ronald L. Reimink, MA, and Harvey D. Blankespoor, PhD

Swimmer's itch (cercarial dermatitis) affects people engaged in open-water activities. We report incidence and risk factors for a US lake. Water exposures and swimmer's itch experience were reported daily for riparian household residents and guests at Douglas Lake, Michigan, in July 2000. Incidence of swimmer's itch was 6.8 episodes per 100 water exposure days. Positive risks were (1) exposures in shallow water and in areas with onshore winds and (2) more days of lake use in July. Further epidemiological studies will help public health agencies address this bothersome problem at recreational lakes. (*Am J Public Health*. 2004;94:738-741)

Cercarial dermatitis, or swimmer's itch, is a skin condition that affects people engaged in open-water activities in fresh and salt-water areas around the world. It causes intense discomfort, discourages recreational water use, and leads to economic loss for lake regions if people decide to vacation elsewhere. Since discovery of the parasites responsible for swimmer's itch,<sup>1</sup> most research has focused on the schistosomes' life cycle and biological control methods.<sup>2-14</sup> The literature on humans and swimmer's itch consists largely of clinical and outbreak reports.<sup>15-28</sup> Epidemiological studies are rare.<sup>29,30</sup> We conducted a prospective study at a Michigan lake to obtain an incidence rate and identify risk factors for swimmer's itch.

The schistosomes for swimmer's itch have a 2-host life cycle, an avian definitive host and a snail intermediate host. At one point in the cycle, snails release cercariae (free-swimming larval stage of the parasite) into the water, where they may encounter and enter ducks and other birds. If instead they penetrate human skin during recreation or work in

the water, an inflammatory response occurs. Mild itching and macular eruptions occur 1 to several hours after a person leaves the water. Intense itching and papules are present 10 to 15 hours later, continuing for about a week. Swimmer's itch is not communicable. Preventive actions before or after water exposure have been proposed, but no scientific evidence exists on their efficacy.

## METHODS

A prospective survey of swimmer's itch among persons with water-based activities was conducted in July 2000 at Douglas Lake, Cheboygan County, Michigan. The lake covers 15.33 sq km and has a maximum depth of 24 to 25 m. Riparian (lake perimeter) households were the target sample. Inclusion criteria were that residents planned to be at the lake for 2 weeks or longer in July and used the lake regularly for swimming, wading, or other activity involving direct contact with the water. Project advertisements were posted around the lake, and households were recruited by personal visit in late June. Participating households filled in a diary for the month of July 2000, a peak period of water use and swimmer's itch complaints. Water exposures and trouble with swimmer's itch were recorded for all residents and guests at the household. The diary booklet had a page for each day, plus information sheets (e.g., swimmer's itch criteria, lake map with numbered areas). Each day, residents and guests were listed by initials, age, and sex.

*Water exposure* information was as follows: total minutes in water (swimming, wading, other recreation or work directly in Douglas Lake), minutes in shallow water (waist deep or less), lake area where most exposure occurred, time of day when most exposure occurred, and whether preventive action was taken (e.g., oil/lotion/wet suit before exposure, brisk brush/alcohol rub after). These items tap hypothesized risk factors for swimmer's itch, namely, long duration in water, shallow-water exposure, locations with shallow shorelines or onshore winds, early- or mid-morning exposure, and human practices to avert or remove cercariae. *Swimmer's itch* information was as follows: number of new itchy spots that day due to swimmer's itch, total itchy spots that day, and degree of dis-

comfort. When a resident or guest departed, no data for subsequent days were entered.

We developed an algorithm to detect *episodes* of swimmer's itch: each day with new itchy spots was linked to water exposure characteristics the same or prior day. Preference was given to exposure that same day, due to the typically short incubation period for symptoms. New spots without same-day or prior-day water exposure were dropped.

## RESULTS

### Descriptive Statistics

Forty households completed the diary for July. The total number of residents and guests at the households was 313. Almost all residents and guests (301; 96.2%) were exposed to water in Douglas Lake in July. The 301 lake users reported 1300 water exposure days. On exposure days, mean time in the water was 49.0 minutes. Shallow-water use was common (89.2% of the days; mean = 39.8 minutes). Exposures occurred at 36 of the 54 lake areas; most (63.4%) were in the afternoon from 2 to 6 PM. Prevention was used on 29.5% of the days.

The swimmer's itch incidence rate was 6.8 episodes per 100 water-exposure days (89 episodes; 95% confidence interval = 5.5, 8.2). Fifty-two people acquired swimmer's itch (17.3% of exposed persons); 58% had 1 episode and 42% had 2 or more.

### Swimmer's Itch Risk Factors: Water-Exposure Days

Significant factors for incidence of swimmer's itch for water-exposure days ( $n=1300$ ) are shown in Table 1. Key bivariate risks were any shallow-water use, location, and preventive action. All episodes occurred on days with shallow-water use. Incidence was highest in south and east lake zones (the 54 lake areas were pooled into 5 zones for analysis; see Table 1, footnote c). Paradoxically, using prevention was positively associated with onset of swimmer's itch. Although observed incidence rose with total minutes and shallow minutes, and was highest for exposures from 6 to 10 AM, those results were not statistically strong ( $P > .10$ ). Age and sex were unrelated to onset of an episode. Logistic regressions with all covari-

ates showed that location and preventive action remained significant.

### Swimmer's Itch Risk Factors: Exposed Persons

Significant factors for incidence of swimmer's itch for people who used the lake in July ( $n=301$ ) are shown in Table 1. Key bivariate risks were number of days of water exposure in July, minutes in water, and minutes in shallow water. Age and sex had no effect. Multivariate analyses confirm the importance of how many days people used the lake.

## DISCUSSION

This study found the following risk factors for onset of swimmer's itch: amount of water exposure, especially shallow-water use; exposure in several lake zones; and taking preventive action. We interpret these results in biologically relevant ways, as follows. (1) *Shallow water* is where snail beds are typically most dense and where cercariae tend to accumulate, so incidence is higher for people using shallow water. More days of lake use increase a person's chances of encountering cercariae at any depth. (2) To explain *location* effects, we assembled existing knowledge about snail densities, duck broods, and weather patterns for Douglas Lake. The most likely reason for elevated incidence in the southern and eastern zones is that persistent winds brought cercariae from the northwestern and western areas, and the sheltered bays prevented the onward movement of incoming and locally produced cercariae. Many factors affect cercarial concentrations from year to year and place to place; our explanation for location differences in 2000 is possible but unproven. (3) Taking *preventive action* before or after exposure was linked to increased risk of swimmer's itch. This aligns with evidence that people's sensitivity to swimmer's itch increases over time.<sup>14</sup> Past bad experience may prompt people to use prevention, but it is apparently insufficient to avert new episodes.

The low incidence rate of 6.8 episodes per 100 water-exposure days is probably related to weather conditions. Summer 2000 was uncommonly cool in northern Lower Michigan. A warmer summer would probably generate higher incidence because cer-

**TABLE 1—Predictors of Swimmer’s Itch Incidence on Water-Exposure Days and for Exposed Persons: Swimmer’s Itch Project, Douglas Lake, Cheboygan County, Michigan, July 2000**

Predictor	% of Water-Exposure Days With Onset or Correlation (r) With Any Episode in July	Odds Ratio From Logistic Regression <sup>a</sup>
<b>Swimmer’s Itch Onset on Days With Water Exposure</b>		
Minutes spent in water	NS	NS
Minutes spent in shallow water	NS	NS
Any shallow water exposure <sup>b</sup>	Yes = 7.6% vs No = 0.0%, †	...
Location of water exposure (on lake) <sup>c</sup>	South = 9.3% vs West = 4.4%, **	South vs West, 2.36, ***
	South = 9.3% vs Northwest = 2.6%, ***	South vs Northwest, 3.89, ***
	North = 8.0% vs West = 4.4%, *	North vs West, 2.05, *
	North = 8.0% vs Northwest = 2.6%, **	North vs Northwest, 3.38, **
	East = 7.5% vs Northwest = 2.6%, *	East vs Northwest, 3.39, *
Time of day	NS	NS
Preventive action taken	Yes = 9.4% vs No = 4.6%, ***	Yes vs No, 2.22, ***
Age	NS	NS
Sex	NS	NS
<b>Any Episode of Swimmer’s Itch in July</b>		
No. of days of water exposure in July	.429, †	1.21, †
Minutes spent in water during July	.279, †	NS
Minutes spent in shallow water during July	.394, †	NS
Age	NS	NS
Sex	NS	NS

Note. Number of water-exposure days = 1300; number of people with water exposure in July = 301. NS = nonsignificant ( $P > .10$ ).

<sup>a</sup>Minutes in water and minutes in shallow water are strongly correlated ( $r = 0.42$  for water-exposure days;  $r = 0.74$  for exposed persons), so regressions are computed with one, then with the other. Results for minutes in water are shown here.

<sup>b</sup>Multivariate analyses are not possible because all episodes occurred on shallow-water exposure days.

<sup>c</sup>Respondents recorded location of their water exposure using a map dividing the lake perimeter into 54 areas. For analyses, the areas were pooled into 5 zones (west, northwest, north, east, south) separated at shore points with bays in between. We tested all pairs of zones for significant differences; significant contrasts are shown here; all others are nonsignificant (NS). \* $P < .10$ ; \*\* $P < .05$ ; \*\*\* $P < .01$ ; † $P < .001$ .

carial production and concentrations increase in warm conditions.

For more information about methods and results, contact the lead author. A longer article including complex variance estimations is forthcoming.<sup>31</sup>

## CONCLUSIONS

The onset of swimmer’s itch depends on how humans interact with the lake. Exposures to shallow water and areas with onshore winds are key risks for swimmer’s itch. The more days a person used the lake in July, the higher his or her chances of having any episode. The underlying biological reasons relate to density of snails, movement of cercariae, and cumulative chances of encountering cercariae. In public health

terms, people should avoid using shallow water and areas with persistent onshore winds. If they still choose such places, the less often, the better. ■

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## Contributors

L.M. Verbrugge was principal investigator, with chief responsibility for project design and analysis. J.J. Rainey performed all data management and computing activi-

ties and worked closely with Verbrugge in interpretation and presentation of results. R.L. Reimink managed the project fieldwork, including household recruitment and contacts. H.D. Blankespoor assisted in project design and selection of Douglas Lake as the site. With longtime knowledge of the lake, Reimink and Blankespoor helped interpret location effects.

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## Human Participant Protection

This nonfunded pilot project followed contemporary survey practice for household recruitment, retention, and contact. Households could cease diary-keeping at any time (2 of 42 did so). No personal identifiers appear in the data.

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# Cancer Burden From Arsenic in Drinking Water in Bangladesh

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We assessed the potential burden of internal cancers due to arsenic exposure in Bangladesh. We estimated excess lifetime risks of death from liver, bladder, and lung cancers using an exposure distribution, death probabilities, and cancer mortality rates from Bangladesh and dose-specific relative risk estimates from Taiwan. Results indicated at least a doubling of lifetime mortality risk from liver, bladder, and lung cancers (229.6 vs 103.5 per 100 000 population) in Bangladesh owing to arsenic in drinking water. (*Am J Public Health*. 2004;94:741–744)

Groundwater contamination caused by inorganic arsenic is a massive public health hazard in Bangladesh.<sup>1–4</sup> The millions of hand-pumped tube wells installed since the 1970s have led to 95% of the country's 130 million residents becoming dependent on supposedly pathogen-free underground water.<sup>5</sup> It is estimated that 25 to 57 million people in Bangladesh have suffered chronic exposure to arsenic,<sup>1,5</sup> and because decades of exposure have already accrued, the exposed population is at an elevated risk of arsenic-induced health problems.

The principal cause of arsenic-induced mortality is cancer,<sup>6–10</sup> but little is known regarding future cancer mortality risks attributable to arsenic exposure among the popula-

tion of Bangladesh.<sup>1</sup> The goal of the present study was to estimate excess lifetime mortality rates for the most-established arsenic-related internal cancers (i.e., lung, liver, and bladder cancers)<sup>7–10</sup> in Bangladesh.

## METHODS

Calculation of lifetime excess risks due to a particular exposure requires measures of distribution of the exposure, “background” lifetime risks, and dose-specific relative risk estimates. In the present study, these measures were estimated as follows.

The arsenic exposure distribution in Bangladesh was ascertained from a sample of 65 876 people who represented the source population of an ongoing prospective cohort study focusing on the health effects of exposure to arsenic in drinking water. Water samples from 5966 contiguous hand-pumped tube wells in a well-defined geographic area of Arahazar, Bangladesh, were collected and tested for arsenic in 2000. Well owners were interviewed to collect data on the numbers and characteristics of the 65 876 regular users.<sup>11</sup>

Gender-specific lifetime mortality risks from liver, bladder, and lung cancers among the population of Bangladesh were derived, via life table methods, from the formula  $\sum S(t_k)P_k$ . Values of  $S(t_k)$  indicate the probability of surviving to the beginning of each of the 5 (i.e.,  $k=1-5$ ) age groups assessed (0–14, 15–44, 45–54, 55–64,  $\geq 65$  years). Survival estimates were based on gender- and age-specific death probabilities among the overall population of Bangladesh.<sup>12</sup> Values of  $P_k$  indicate gender-, age-, and cancer-specific mortality rates in Bangladesh; these rates were computed by the International Agency for Research on Cancer (IARC).<sup>13–16</sup>

Gender-specific, age-adjusted relative risks of liver, bladder, and lung cancer mortality due to arsenic exposure were computed on the basis of gender- and age-specific data on arsenic exposure, cancer mortality, and at-risk population obtained from studies conducted in Taiwan (detailed data regarding a published study<sup>17</sup> were obtained from C.J. Chen and L. Ryan, January 2002). We used Poisson regression models in calculating these risk estimates, allowing us to compare rates for different levels of arsenic exposure in an en-

demographic area with those in the general population of Taiwan.

Finally, we estimated lifetime excess mortality risks attributable to different levels of arsenic exposure by multiplying gender-specific, age-adjusted excess relative risks from Taiwan by the corresponding category-specific lifetime risks for each cancer in Bangladesh. We weighted these estimates by the arsenic exposure distribution ascertained from our study population in Bangladesh to derive overall lifetime excess risk estimates.

**RESULTS**

Results showed that, among the overall population of Bangladesh, lifetime mortality risks (per 100 000 population) of cancer of the bladder, lung, and liver were 5.4, 159.1, and 9.2 for males and 0.3, 23.1, and 9.5 for females, respectively. The overall mortality risk for the 3 cancers in combination was 103.5 per 100 000 (Table 1).

Lifetime excess risks (per 100 000 population) of mortality from liver, bladder, and lung cancers attributable to arsenic in drinking water were 0.9, 21.5, and 175.9 for males and 3.4, 2.1, and 48.3 for females, respectively (Table 2). Overall lifetime excess mortality risks (per 100 000) from the 3 cancers in combination were 198.3 for males and 53.8 for females, with an average across-gender lifetime risk of 126.1.

**DISCUSSION**

Our study indicates a more than doubling of future excess mortality in Bangladesh owing to cancer of the lung, liver, and bladder resulting from exposure to arsenic in drinking water (i.e., a rate of 229.6 per 100 000 population vs the background overall risk of 103.5 per 100 000 population). Our analyses employed a straightforward method measuring excess lifetime risks on an additive scale. A similar approach has been applied to predict the cancer burden due to arsenic exposure in the United States.<sup>18</sup>

Several uncertainties involved with our estimations warrant caution in interpreting our findings. First, in generating our exposure distribution, we were unable to pool data from other large-scale surveys conducted in

**TABLE 1—Cumulative Lifetime (Background) Mortality Risks (per 100 000 Population) From Bladder, Liver, and Lung Cancers: Bangladesh, 2000**

Gender and Age Group, y	Survival Probability <sup>a</sup>	Liver Cancer		Lung Cancer		Bladder Cancer	
		Mortality Rate <sup>b</sup>	Age-Specific Risk	Mortality Rate <sup>b</sup>	Age-Specific Risk	Mortality Rate <sup>b</sup>	Age-Specific Risk
<b>Male</b>							
0-14	1.00	0.01	0.01	0.03	0.03	0.00	0.00
15-44	0.85	0.35	0.30	2.22	1.89	0.12	0.10
45-54	0.78	1.54	1.20	28.00	21.74	0.87	0.68
55-64	0.70	4.83	3.38	79.83	55.81	2.22	1.55
≥65	0.54	7.99	4.34	146.49	79.60	5.70	3.10
Lifetime mortality risk (per 100 000) <sup>c</sup>			9.22		159.07		5.43
<b>Female</b>							
0-14	1.00	0.03	0.03	0.00	0.00	0.00	0.00
15-44	0.86	0.40	0.34	0.76	0.66	0.05	0.04
45-54	0.76	4.24	3.24	6.66	5.08	0.09	0.07
55-64	0.68	3.80	2.60	10.38	7.10	0.24	0.16
≥65	0.55	6.00	3.28	19.41	10.60	0.00	0.00
Lifetime mortality risk (per 100 000) <sup>c</sup>			9.49		23.44		0.28

<sup>a</sup>Probability of surviving to the beginning of year *t* (first year) in each age group *k*. The survival probability can be denoted by  $S(t_k)$  where  $t = 0, 15, 45, 55, \text{ and } 65$ ;  $k = 1-5$ . Probability estimates were calculated on the basis of category-specific death probabilities in Bangladesh.

<sup>b</sup>Age-specific mortality rates ( $P_k$ ) for the population of Bangladesh (per 100 000), estimated by the International Agency for Research on Cancer for the year 2000.

<sup>c</sup>Lifetime (background) mortality risks were calculated via the formula  $\sum S(t_k)P_k$ .

Bangladesh since water samples in those surveys were not collected in a systematic manner and the population distributions of the individual exposure categories were unknown. However, the extent of arsenic contamination in our study area was comparable to estimates reported in those large-scale surveys.<sup>2,5,19</sup>

Second, the dose-specific relative risk estimates we used in predicting risks were derived from Taiwan data, since no such estimates are currently available in Bangladesh. Data from Taiwan have also been used in most arsenic risk assessments for the US population.<sup>18,20-22</sup> Given the long latency of arsenic-induced cancer and the similarity in durations of well water use between the exposed populations of Taiwan (1910s-1970s)<sup>7</sup> and Bangladesh (since the 1940s),<sup>19</sup> the effects of arsenic are assumed to be similar in the 2 populations.

Although our relative risk estimates did not demonstrate a strict dose-response pattern, lifetime excess risk estimates did not change appreciably when the exposure categories

were grouped differently (data not shown). However, the impact of potential differences in the distributions of other risk factors related to the studied cancers between the populations of Bangladesh and Taiwan is unknown. The prevalence of cigarette smoking among Bangladeshi men (56-72%) is higher than the prevalence reported in the Taiwan study from which we generated the present relative risk estimates (32%), and nutritional deficiency is more prevalent in Bangladesh.<sup>23-25</sup> Hepatitis B virus infection was probably more prevalent in Taiwan in the 1980s, the period during which the relative risk estimates used in the present study were derived.<sup>26,27</sup> Whether the 2 populations are comparable in terms of arsenic-related genetic factors is unknown.

Finally, the IARC estimated cancer mortality rates for Bangladesh on the basis of cancer incidence rates in India, age-specific cancer ratios in Bangladesh, and cancer survival rates in developing countries.<sup>13-16</sup> Because cancer mortality data are scant in

**TABLE 2—Lifetime Excess Mortality Risks (per 100 000 Population) From Bladder, Liver, and Lung Cancers: Bangladesh**

Cancer Type	Arsenic Concentration in Water, µg/L	Rate Ratio <sup>a</sup>	Lifetime Mortality Risk <sup>b</sup>	Exposure Population, % <sup>c</sup>	Excess Mortality Rate <sup>d</sup>
<b>Bladder</b>					
Male	< 50	5.80	5.43	46.03	12.00
	50–99	2.29	5.43	18.16	1.27
	100–299	4.09	5.43	28.92	4.85
	300–599	9.57	5.43	6.52	3.03
	≥ 599	16.87	5.43	0.38	0.32
	Total				21.48
Female	< 50	10.75	0.28	46.03	1.26
	50–99	4.15	0.28	18.16	0.16
	100–299	6.75	0.28	28.92	0.47
	300–599	12.97	0.28	6.52	0.22
	≥ 599	25.79	0.28	0.38	0.03
	Total				2.13
<b>Lung</b>					
Male	< 50	1.81	159.07	46.03	59.31
	50–99	1.00	159.07	18.16	0.00
	100–299	2.95	159.07	28.92	89.70
	300–599	3.41	159.07	6.52	24.99
	≥ 599	4.22	159.07	0.38	1.93
	Total				175.92
Female	< 50	2.95	23.44	46.03	21.04
	50–99	2.44	23.44	18.16	6.13
	100–299	3.27	23.44	28.92	15.39
	300–599	4.29	23.44	6.52	5.03
	≥ 599	9.00	23.44	0.38	0.71
	Total				48.29
<b>Liver</b>					
Male	< 100 <sup>e</sup>	0.91	9.22	64.19	-0.53
	100–299	1.40	9.22	28.92	1.07
	300–599	1.54	9.22	6.52	0.32
	≥ 599	2.15	9.22	0.38	0.04
	Total				0.90
Female	< 100 <sup>e</sup>	0.99	9.49	64.19	-0.06
	100–299	2.16	9.49	28.92	3.18
	300–599	1.39	9.49	6.52	0.24
	≥ 599	2.54	9.49	0.38	0.05
	Total				3.42

<sup>a</sup>Age-adjusted rate ratios estimated, via Poisson regression, through data from Taiwan, with mortality rates in southwestern region of Taiwan as the reference category.

<sup>b</sup>Background mortality risks in Bangladesh, estimated as lifetime risks per 100 000 population (from Table 1).

<sup>c</sup>Percentage of the study population in Araihazar, Bangladesh (n = 65 876), using well water at each arsenic concentration for drinking and cooking purposes.

<sup>d</sup>Lifetime excess mortality rate per 100 000 population attributable to arsenic in drinking water.

<sup>e</sup>Data for finer exposure categories (< 100 µg/L) were not available for liver cancer.

Bangladesh, it is difficult to evaluate the validity of the IARC estimates. However, given the geographic and sociocultural similarities of India and Bangladesh, and the dissimilar-

ity of the 2 countries in regard to arsenic exposure, the IARC estimates are probably the best data available for estimating “background” lifetime risks.

In conclusion, our results suggest at least a doubling of the potential cancer burden in Bangladesh due to arsenic exposure. Measures focusing on reductions in arsenic exposure, early diagnosis, and treatment of arsenic-induced cancers are thus urgently warranted. In addition, risk estimates derived directly from individual-level data are needed for more precise risk assessments tailored to the population of Bangladesh. Prospective analyses based on our ongoing epidemiological cohort study will address this issue in the near future. ■

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### Contributors

H. Ahsan conceptualized and designed the study. Y. Chen conducted data analyses and led the writing of the article.

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### Human Participant Protection

No protocol approval was needed for this study.

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## Computer Access and Internet Use Among Urban Youths

Amy Bleakley, MPhil, MPH, Cheryl R. Merzel, DrPH, Nancy L. VanDevanter, DrPH, and Peter Messeri, PhD

This report presents data on computer access, Internet use, and factors associated with health information seeking on the Internet among a sample of youths aged 15 to 30 years in New York City. Findings from street intercept surveys indicate substantial computer access at home (62%) and frequent (everyday or a few times a week) Internet use (66%). Fifty-five percent of the sample reported seeking health information on the Internet, which was associated with positive beliefs about getting a health checkup and frequent Internet use. (*Am J Public Health*. 2004;94:744–746)

An estimated 54% of urban households use the Internet, with use highest among youths aged 9 to 17 (69%) and 18 to 24 years (65%).<sup>1</sup> Accordingly, there is enormous potential for the Internet as a source of health information and as a component of health promotion pro-

grams. Studies show that up to 60% of adults with Internet access have searched for health or medical information.<sup>2,3</sup> Children and adolescents also report using the Internet as a resource for health information, although not as extensively as adults.<sup>4–6</sup> This report presents data on Internet access and use among a sample of youths in New York City and describes the extent to which they use the Internet for seeking health information.

### METHODS

Measures were developed as part of a larger sexually transmitted disease (STD) prevention study. Street intercept interviews were conducted in Central Harlem and Bedford Stuyvesant, New York City, 2 communities that are comparable regarding demographics such as income and racial composition. Measures relevant to the current analysis include availability of a computer at home, school, or community-based organization; frequency of Internet use; reasons for going online; beliefs about going for a health checkup at least once a year (7-point Likert scale from negative to positive), and knowledge of STDs (7-item scale).

A structured sampling design was used to select locations with high volumes of young adults. Twelve sites were chosen randomly, 6 in each area, from a larger group of identified locations. Surveys were conducted at various times throughout the day, mainly after school, to obtain a cross-section of community members. Data collection occurred at several venues, including housing developments, shopping areas, and near schools. Eligibility was based on zip code residence and age (15–30 years); subway tokens were given as compensation. Trained interviewers collected data in the summer of 2001 in Harlem and in the winter of 2002 in Bedford Stuyvesant. Refusal rates are unavailable owing to the nature of street interviews; however, any passerby was approached to participate, with the exception of individuals clearly not in the specified age range, or if the interviewer was already conducting an interview.

### RESULTS

Fifty-five percent of the sample (n=285) was from Harlem. The sample was 51% fe-

**TABLE 1—Computer Access and Internet Use (%) by Age: Central Harlem and Bedford Stuyvesant, New York City**

	Ages 15-18 (n = 130)	Ages 19-30 (n = 149)	Total (n = 279)
Computer available at home	67	57	62
Computer available at a local community-based organization	77	56	66***
Computer available at school <sup>a</sup>	91	55	77***
Internet use			
Every day	29	24	26
Few times/wk	40	41	40
Few times/mo or less	27	17	22
Never	4	19	12
Reasons for Internet use <sup>b</sup>	(n = 125)	(n = 125)	(n = 250)
E-mail (n = 189)	72	79	76
Chat rooms (n = 143)	66	48	57**
Games (n = 192)	83	72	77*
Music lyrics/sports pages (n = 211)	90	79	85*
Look up information on health issues (n = 136)	51	58	55
Look up information in general (n = 216)	82	91	86*

<sup>a</sup>Only students included in this category. For ages 15 to 18, n = 120; for ages 19 to 30, n = 59; for total sample, n = 181.

<sup>b</sup>Only Internet users included in this category. For ages 15 to 18, n = 125; for ages 19 to 30, n = 125; for total sample, n = 250.  
\**P* < .05; \*\**P* < .01; \*\*\**P* < .001.

**TABLE 2—Logistic Regression Analysis of Looking Up Health Information on the Internet: Central Harlem and Bedford Stuyvesant, New York City**

	Odds Ratio	95% Confidence Interval
Age	1.05*	0.991, 1.12
Gender	1.54*	0.939, 2.54
Computer access		
Home	1.37	0.811, 2.30
School	0.914	0.475, 1.76
Local CBO	1.56	0.891, 2.73
Internet use <sup>a</sup>		
Every day	1.01	0.584, 1.75
Few times/wk	1.69**	1.02, 2.80
Few times/mo or less	0.634	0.358, 1.12
STD knowledge <sup>b</sup>	1.21*	0.985, 1.48
Health care visit in past 12 mo		
For any reason	1.11	0.631, 1.97
For a health checkup	1.06	0.617, 1.83
Beliefs about going for health checkup at least once a year <sup>c</sup>		
"Would be embarrassing."	0.955	0.825, 1.11
"Would be scary."	0.961	0.852, 1.08
"Would show I care about my health."	1.46**	1.06, 2.03

Note. CBO = community-based organization; STD = sexually transmitted disease.

<sup>a</sup>Referent group is respondents who reported never having used Internet.

<sup>b</sup>0 = no correct responses; 7 = all responses correct.

<sup>c</sup>1 = strongly disagree; 7 = strongly agree.

\**P* < .10; \*\**P* .05.

male, with a mean age of 20.3 years; 81% identified themselves as African American and 13% as Hispanic.

### Computer Availability

Table 1 presents computer availability by age, which is stratified according to school enrollment age. Most of the sample reported access to a computer at home (62%), at a local community-based organization (66%), or at school (77%). Younger respondents displayed higher rates of access at community-based organizations and school compared with other ages.

### Internet Use

Two thirds of respondents used the Internet either every day or a few times a week (Table 1). Twelve percent reported never using the Internet; this percentage was much higher among the older (18.9%) than the younger (3.9%) age group.

### Reasons for Internet Use

Fifty-five percent of Internet users reported seeking health information on the Internet, with no gender or age differences (Table 1). Younger respondents were more likely than older respondents to use the Internet for chat

rooms, to play games, and to visit music or sports pages. Older respondents were more likely to look up general information. Other than males being more likely to access music or sports pages, there were no gender differences in reasons for Internet use.

### Looking Up Health Information

Bivariate logistic regression analysis shows that the odds of looking up health information on the Internet was significantly higher among respondents who agreed with the statement, "Going for a health care checkup at least once a year shows that I care about my health," as well as for those reporting Internet use a few times a week (Table 2). Other beliefs about checkups (i.e., that they would be embarrassing or scary) were not associated with seeking health information. High STD knowledge, age, and being female were all marginally significant (*P* < .10).

### DISCUSSION

Findings from these 2 urban communities suggest that computer access and Internet use rates from this study population are comparable to the national estimates.<sup>1,7</sup> The percent-

age of respondents having a home computer is substantial, and even more so among school-age adolescents. In addition, the availability of computers at school and at a community-based organization indicates broad community familiarity with these technologies.

Since study measures were limited to basic information on Internet use, more research on the specific types of health information sought would be useful. Respondents reporting using the Internet a few times a week are more likely than others to look up health information, suggesting that intermittent users may use the Internet specifically for information gathering compared with more frequent users.

The Internet enables adolescents to explore topics like sexual health in a confidential and anonymous manner. Pervasive Internet use makes alternative data collection methods (e.g., online surveys) feasible, and information technologies can be used to enhance youth health promotion programs and media campaigns. ■

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### Contributors

A. Bleakley wrote the text and analyzed the data. C.R. Merzel, N.L. VanDevanter, and P. Messeri contributed to the study design and implementation and reviewed early manuscript drafts.

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### Human Participant Protection

This study was approved by the institutional review boards at Columbia University and the Centers for Disease Control and Prevention.

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# Social Factors and Periodontitis in an Older Population

Luisa N. Borrell, DDS, PhD, Brian A. Burt, BDS, PhD, Harold W. Neighbors, PhD, and George W. Taylor, DMD, DrPH

The pervasiveness of health disparities by socioeconomic status (SES) in the United States has been documented for years.<sup>1–6</sup> Regardless of race or ethnicity, health outcomes for individuals of lower SES continue to be poorer than those of their higher-SES counterparts.<sup>3,7</sup> This is also true for periodontal health: for years, the data have shown significant SES differences across racial/ethnic groups.<sup>8–18</sup> Many previous studies documenting differences in periodontal health have included SES indicators (i.e., income and education) in their analyses. Some studies have provided cross-tabulations between periodontitis and categories for each SES indicator,<sup>19–25</sup> whereas others have included these indicators as covariates in multivariable analysis approaches.<sup>22,23,25–29</sup> The first group of studies has reported higher prevalences and severity of periodontitis for those with lower SES compared with their higher-SES counterparts. The second group has documented the persistence of racial/ethnic differences after adjusting for SES indicators. However, the incommensurability of these indicators across racial/ethnic groups has not been discussed in these studies. To date, SES indicators have not been investigated as the main independent covariates in studies of periodontal health. Therefore, their contribution to the existing racial/ethnic differences or to the disparity in the prevalence of periodontitis in general remains unknown.

To address these issues and expand our previous work on racial/ethnic differences in periodontitis, we ascertained prevalences of periodontitis for (1) income and (2) education among non-Hispanic Black, Mexican-American, and non-Hispanic White adults aged 50 years or older using data from the third National Health and Nutrition Examination Survey (NHANES III). In addition, we investigated the combined effect of income and education on the prevalence of periodontitis. Finally, in this article we discuss the pathways by which SES indicators intertwined with race/ethnicity to affect periodontal health.

**Objectives.** We assessed the prevalences of periodontitis by education and income levels among US adults with data from the third National Health and Nutrition Examination Survey.

**Methods.** The study was limited to non-Hispanic Blacks, Mexican Americans, and non-Hispanic Whites 50 years of age or older with a complete periodontal assessment during the dental examination.

**Results.** Blacks with higher education and income levels had a significantly higher prevalence of periodontitis than their White and Mexican-American counterparts. The relationship between income level and periodontitis was modified by race/ethnicity. High-income Blacks exhibited a higher prevalence of periodontitis than did low-income Blacks and high-income Whites.

**Conclusions.** Our findings call attention to the importance of recognizing socioeconomic status–related health differences across racial/ethnic groups within the social, political, and historical context. (*Am J Public Health.* 2004;94:748–754)

## METHODS

We used data from a subsample of NHANES III, conducted from 1988 to 1994. This survey used a complex sampling design to select the civilian, noninstitutionalized US population aged 2 months or older.<sup>30</sup> A complete description of the plan and operation of NHANES III has been given elsewhere.<sup>31</sup> Of the total adult sample ( $n=20\,050$ ), 8654 persons were aged 50 years or older; of these, 5124 (59.2%) were dentate. Furthermore, 4375 received a periodontal assessment with 80.7% receiving a complete assessment. There were 646 (12.6%) persons excluded from the periodontal assessment for medical reasons. These exclusions were proportional across racial/ethnic groups. Data for this analysis were restricted to 3407 persons aged 50 years or older who reported their racial/ethnic identity as non-Hispanic Black ( $n=718$ ), non-Hispanic White ( $n=1815$ ), or Mexican American ( $n=874$ ) and who received a complete periodontal assessment during the NHANES III dental examination. Hereafter, we refer to non-Hispanic Blacks as Blacks and non-Hispanic Whites as Whites.

## Study Variables

During the dental examination, 6 dentists trained in the survey examination protocol conducted the periodontal examinations.<sup>31</sup> Briefly, the periodontal examination was conducted in

2 randomly chosen quadrants, 1 maxillary and 1 mandibular, on the assumption that conditions in these 2 quadrants would represent the mouth. Two sites, midbuccal and mesiobuccal, were examined for each tooth. Examiners used a periodontal probe to measure clinical attachment loss (CAL) and pocket depth (PD). CAL was defined as the distance in millimeters from the cemento-enamel junction to the base of the pocket/sulcus, and PD as the distance from the free gingival marginal to the base of the pocket/sulcus. Third molars were excluded because of their frequent extraction in young adulthood, so a maximum of 14 teeth and 28 sites per individual were examined. When defining periodontitis, there is very little agreement on the case definitions across studies. However, previous studies have used several combinations of CAL and PD to establish periodontitis case definitions.<sup>25,27,32–34</sup> Moreover, these studies have been tailored to test specific hypotheses. For this study, to arrive at the definition used in the analyses, we tested several definitions used in previous studies as well as the distribution of CAL and PD in the total population and in each racial/ethnic group of this study. The final definition was established before any hypothesis testing. Periodontitis was defined as a composite of at least 4 sites with  $CAL \geq 5$  mm and at least one site with  $PD \geq 4$  mm. However, these conditions did not have to be present in the same site.

The main covariates for this analysis were education, income, and race/ethnicity. Education was collected as a continuous variable (number of years of education) from zero to 17 years and was categorized as follows: <12 years and  $\geq 12$  years of education. The yearly income of a family was collected as a continuous variable and was categorized as follows: <\$20 000 and  $\geq$ \$20 000. Race/ethnicity was self-reported by the study's participants and selected from 4 categories: non-Hispanic Black, non-Hispanic White, Mexican American, and Other.

Covariates recognized as risk indicators for periodontitis were selected for the analysis.<sup>17–22,35–40</sup> The covariates were age at interview, gender, marital status, time since last dental visit, presence of health insurance, self-reported diabetes, and tobacco use. In addition, dental calculus and missing teeth were investigated as covariates.<sup>41–43</sup> Gender (male/female), currently employed (yes/no), and presence of health insurance (yes/no) were used in this analysis as collected in NHANES III. Age at interview was used as a continuous and categorical variable. Age categories used were 50 to 59, 60 to 69, and 70 years or older. Categories for the marital status variable were married (married or living together with someone as married), single, divorced (separated or divorced), and widowed. Time since last dental visit was collected as a continuous variable (days since last seeing a dentist) and categorized as follows:  $\leq 6$  months, >6 months to <1 year, and  $\geq 1$  year.

The question “Have you ever been told by a doctor that you have diabetes?” was used to assess the history of diabetes. Women who manifested diabetes only during pregnancy were not considered to have diabetes. Smoking status was derived from 2 questions: “Do you smoke cigarettes now?” and “Have you smoked at least 100 cigarettes in your life?” Smoking status was defined as current smokers (subjects who answered “yes” to both questions), former smokers (subjects who answered “no” to the first question and “yes” to the second question), and never smokers (subjects who answered “no” to both questions).

During the periodontal examination, dental calculus was assessed in 2 sites, midbuccal and mesiobuccal, for the 2 randomly selected quadrants. Calculus was recorded as the ab-

sence of calculus, presence of supragingival calculus only, or presence of either subgingival calculus only or both types of calculus (supragingival and subgingival). For this analysis, calculus was specified as the presence or absence of calculus on at least 1 site per tooth. A variable to account for missing teeth was created by subtracting the number of teeth present in the mouth from the 28 teeth considered during the dental examination.

### Statistical Analysis

Characteristics of the population and prevalence of periodontitis were described for each covariate stratified by race/ethnicity. To assess differences in the prevalence of periodontitis, we performed 3 sets of  $\chi^2$  tests: first, we used the Cochran–Mantel–Haenszel test to evaluate the independence between periodontitis and race/ethnicity, after controlling for each covariate separately. Second, we applied the homogeneity test for equal prevalence of periodontitis for each racial/ethnic group over covariate categories. Finally, we applied the independence test to examine for equal prevalence of periodontitis across racial/ethnic group within each covariate category.

Unadjusted and adjusted prevalences of periodontitis and 95% confidence limits for (1) income and (2) education categories were estimated from logistic regression models for each racial/ethnic group before and after adjusting for demographic and health-related covariates. We used a step-down method to select the covariates that significantly contributed to each model.<sup>44</sup> This method, similar to the backward-selection method, takes into account not only the changes of the  $\beta$  coefficients of the other covariates when including and excluding each nonsignificant covariate from the model but also the possible correlations among covariates. The final model for income includes education during adjustment and vice versa. To investigate the combined effect of income and education, we also estimated the unadjusted and adjusted prevalence of periodontitis and the 95% confidence interval from logistic regression models. Prevalence of periodontitis for 4 cross-classified categories of income and education (i.e., high income and high education, high income and low education, low income and high education, and low income and low education) were calculated

for each racial/ethnic group before and after adjusting for all other covariates in the model. Ratios of adjusted prevalence of periodontitis and their 95% confidence interval between racial/ethnic groups were calculated for each category of income and education as well as for the joint effects of income and education. In a logistic regression model including race/ethnicity as an independent covariate, 2-way interaction terms between race/ethnicity and (1) education and (2) income were tested. A significant interaction between race/ethnicity and income was found and reported.

We carried out all data management procedures with SAS<sup>45</sup> and carried out the statistical analyses using SUDAAN.<sup>46</sup> SUDAAN takes into account the weights provided in the data set yielding unbiased standard error estimates. In the tables, the sample sizes were unweighted. However, estimates for means, proportions, standard errors, and 95% confidence intervals were weighted.

## RESULTS

### Characteristics of the Population

Table 1 shows the characteristics of the study population for selected covariates by race/ethnicity. When compared with Whites, Blacks and Mexican Americans were younger, were less educated, had lower income, were less likely to have had a dental visit within the past 6 months, and were more likely to report having diabetes (all  $P$  values <.05). In addition, Blacks exhibited the highest proportion of current smokers and were less likely to be married, whereas Mexican Americans were more likely to be males and uninsured.

### Prevalence of Periodontitis

Blacks had worse periodontal clinical conditions than Mexican Americans and Whites (data not shown). In addition, Blacks were more likely to have calculus, higher mean CAL and PD, and a lower mean number of teeth.

Table 2 shows the prevalence of periodontitis for each racial/ethnic group for selected covariates. The overall prevalence of periodontitis in this population was 6.3%. Blacks exhibited the highest prevalence (14.2%), followed by Mexican Americans (9.4%) and Whites (5.3%). However, the differences between racial/ethnic groups were not statisti-

**TABLE 1—Characteristics of Non-Hispanic Black, Non-Hispanic White, and Mexican American Adults Aged 50 Years and Older: Third National Health and Nutrition Examination Survey, 1988–1994<sup>a</sup>**

	% (SE)			
	Blacks (n = 718)	Mexican Americans (n = 874)	Whites (n=1815)	Total <sup>b</sup> (n = 3533)
Age, y, mean (SE)	61.6 (0.50)	59.7 (0.33)	62.6 (0.41)	62.2 (0.36)
Age groups, y				
50–59	48.3 (0.94)	54.8 (0.45)	42.9 (1.97)	45.2 (1.71)
60–69	32.0 (2.29)	34.5 (2.08)	33.9 (1.41)	33.4 (1.11)
≥70	19.7 (1.85)	10.7 (1.47)	23.2 (1.53)	21.4 (1.33)
Gender				
Male	45.9 (1.50)	50.5 (1.91)	48.6 (1.13)	48.7 (0.94)
Female	54.1 (1.50)	49.5 (1.91)	51.4 (1.13)	51.2 (0.94)
Marital status				
Married	52.2 (1.79)	74.3 (1.77)	74.2 (1.54)	72.5 (1.35)
Single	6.0 (0.86)	2.2 (0.53)	3.2 (0.41)	3.6 (0.40)
Divorced	21.3 (1.77)	11.9 (1.64)	9.7 (1.03)	10.7 (0.94)
Widowed	20.5 (1.51)	11.7 (1.64)	12.9 (0.88)	13.2 (0.75)
Education, y				
<12	52.1 (2.53)	70.8 (2.89)	19.9 (1.58)	25.7 (1.55)
≥12	47.9 (2.53)	29.2 (2.89)	80.1 (1.58)	74.3 (1.55)
Income				
<\$20 000	53.9 (2.93)	57.9 (2.62)	23.8 (1.67)	28.0 (1.66)
≥\$20 000	46.1 (2.93)	42.2 (2.62)	76.2 (1.67)	72.0 (1.66)
Presence of health insurance				
Yes	92.4 (1.33)	87.8 (2.34)	97.9 (0.38)	97.0 (0.40)
No	7.6 (1.33)	12.2 (2.34)	2.1 (0.38)	3.0 (0.40)
Time since last dental visit				
≤6 mo	31.6 (2.30)	35.7 (2.56)	64.9 (1.65)	59.8 (1.67)
>6 mo and <1 y	20.7 (1.92)	20.8 (1.97)	16.9 (1.03)	17.4 (0.90)
≥1 y	47.7 (2.15)	43.5 (2.18)	18.2 (1.16)	22.8 (1.23)
Diabetes				
Yes	14.4 (1.31)	18.2 (1.58)	7.6 (0.68)	8.4 (0.51)
No	85.6 (1.31)	81.8 (1.58)	92.4 (0.68)	91.6 (0.51)
Smoking status				
Current smokers	26.7 (2.08)	17.8 (1.76)	14.5 (1.08)	15.8 (0.94)
Former smokers	26.9 (1.81)	35.7 (1.98)	39.8 (1.56)	37.6 (1.29)
Never smokers	46.3 (2.40)	46.5 (1.86)	45.6 (1.65)	46.6 (1.37)

<sup>a</sup>Sample sizes are unweighted; means, proportions, and standard errors are weighted to take into account Third National Health and Nutrition Examination Survey sample design.

<sup>b</sup>Total includes Others.

cally significant. In general, the prevalence of periodontitis was highest among males, those without insurance, those without a dental visit within the last 6 months, those with a self-reported history of diabetes, and those who smoked. Blacks exhibited the highest prevalence in all categories except for the presence of health insurance, in which category Whites had the highest prevalence. The prevalence of periodontitis was lowest for the youngest ages in each of the 3 racial/ethnic groups; how-

ever, only Whites showed a monotonic increase in prevalence of periodontitis over the 3 age groups. For marital status, the pattern for the prevalence of periodontitis was somewhat different for each racial/ethnic group, with married people exhibiting the lower prevalence regardless of their race/ethnicity.

Prevalences and prevalence ratios of periodontitis for education and income categories for each racial/ethnic group are presented in Table 3. Blacks exhibited the highest preva-

lence for both categories of education. This pattern remained after adjustment for age, gender, presence of insurance, time since last dental visit, history of diabetes, smoking, and income. Blacks exhibited significantly higher adjusted prevalences of periodontitis independent of their education than their White and Mexican-American counterparts. In fact, Blacks in the higher education group exhibited prevalences of periodontitis that were 2.3 and 4.9 times higher than those of their White and Mexican-American counterparts, respectively. This pattern was consistent for income categories. However, high-income Blacks exhibited higher adjusted prevalence of periodontitis than their low-income counterparts.

When the unadjusted joint effects of income and education were considered, those with both higher education and higher income exhibited the lowest prevalences of periodontitis regardless of racial/ethnic group. After adjusting for all covariates in the model, this pattern remained for Whites, whereas for Mexican Americans and Blacks, those with high education but low income exhibited the lowest prevalence of periodontitis.

Figure 1 shows a significant interaction between income and race/ethnicity on the prevalence of periodontitis after adjusting for age, gender, education, presence of insurance, time since last dental visit, smoking, and diabetes ( $P=.006$ ). Blacks exhibited a direct association between income and periodontitis, whereas their White counterparts exhibited the expected inverse association. This pattern remained unchanged when 3 categories for income (i.e., ≤\$16 999, \$17 000–\$34 999 and ≥\$35 000) were used in the analysis. Mexican Americans exhibited a prevalence of 2.0% for both categories, low and high income (data not included in the figure). The absolute values of the estimated net effects of income (adjusted for other covariates) on the prevalence of periodontitis for Blacks and Whites were not too different, although they were in different directions (3.1 % increase for Blacks and 3.6% decrease for Whites).

## DISCUSSION

To our knowledge, there has been no study assessing the association between the prevalence of periodontitis and income and

**TABLE 2—Prevalence of Periodontitis for Selected Covariates Among Non-Hispanic Black, Non-Hispanic White, and Mexican American Adults Aged 50 Years and Older: Third National Health and Nutrition Examination Survey, 1988–1994**

	% (SE)			
	Blacks (n = 718)	Mexican Americans (n = 874)	Whites (n = 1815)	Total (n = 3533)
Overall prevalence	14.2 (1.45)	9.4 (1.48)	5.3 (0.62)	6.3 (0.59)
Age groups, y				
50–59	10.5 (1.99)	5.7 (1.65)	4.4 (0.92)	5.6 (0.83)
60–69	18.7 (2.77)	15.0 (2.17)	4.9 (0.97)	6.1 (0.86)
≥70	15.6 (2.34) <sup>a</sup>	9.3 (2.57)	7.1 (1.25) <sup>a</sup>	7.8 (1.22)
Gender				
Male	19.4 (2.42)	15.0 (2.60)	8.0 (1.05)	9.3 (1.08)
Female	9.9 (1.78)	3.7 (1.20)	2.8 (0.59)	3.5 (0.54)
Marital Status				
Married	13.0 (2.38)	9.7 (1.69)	5.1 (0.74)	5.9 (0.68)
Single	19.7 (7.45)	10.0 (6.06)	6.8 (3.33) <sup>b</sup>	7.7 (2.83)
Divorced	14.0 (3.37)	10.0 (4.73)	7.2 (1.93) <sup>b</sup>	8.4 (1.64)
Widowed	16.2 (3.10) <sup>a</sup>	7.0 (2.29) <sup>a</sup>	4.7 (1.36) <sup>a</sup>	6.5 (1.27)
Presence of health insurance				
Yes	11.9 (1.89)	5.1 (1.32)	4.6 (0.57)	5.0 (0.57)
No	13.9 (5.24) <sup>a</sup>	9.3 (4.60) <sup>a</sup>	17.8 (6.95) <sup>b</sup>	14.2 (4.41)
Time since last dental visit				
≤6 mo	8.2 (2.08)	5.4 (1.57)	3.0 (0.50)	3.7 (0.58)
>6 mo	13.1 (2.40)	8.3 (1.99)	6.6 (1.66) <sup>b</sup>	7.1 (1.23)
≥1 y	18.4 (2.24)	12.3 (2.99) <sup>a</sup>	11.9 (2.01) <sup>b</sup>	12.1 (1.48)
Diabetes				
Yes	15.3 (3.75)	12.0 (2.88)	8.6 (2.57) <sup>b</sup>	9.6 (2.02)
No	14.1 (1.47) <sup>a</sup>	8.8 (1.48) <sup>a</sup>	5.0 (0.63) <sup>a</sup>	6.0 (0.61)
Smoking status				
Current smokers	21.1 (3.02)	17.1 (3.31)	14.1 (2.58) <sup>b</sup>	16.4 (2.37)
Former smokers	13.8 (2.73)	9.8 (3.17)	6.1 (1.07)	6.5 (0.95)
Never smokers	10.6 (2.08) <sup>a</sup>	6.2 (1.16)	1.8 (0.41)	2.7 (0.45)

<sup>a</sup>Chi-squared test of homogeneity (to examine for equal prevalence of periodontitis for each racial/ethnic group over covariate categories) nonsignificant at  $P \geq .05$ .

<sup>b</sup>Chi-squared test of independence (to examine for equal prevalence of periodontitis across racial/ethnic group within each covariate category) nonsignificant at  $P \geq .05$ . Chi-squared tests for Cochran-Mantel-Haenszel test (to evaluate the independence between periodontitis and race/ethnicity, after controlling for each covariate separately) were all significant at  $P < .0001$ .

education across racial/ethnic groups in older adults. Our study found that Blacks with higher education and income had a significantly higher prevalence of periodontitis than their White and Mexican-American counterparts. Furthermore, the prevalence of periodontitis for income categories was different for each racial/ethnic group. High-income Blacks exhibited a higher prevalence of periodontitis than low-income Blacks and high-income Whites. These findings persist when 3 categories for income were considered in the analyses. For Mexican Americans, there was some variation in the preva-

lence of periodontitis with respect to their White counterparts, ranging from lower to slightly higher prevalences. When cross-classified categories for income and education were considered in the model, Blacks with higher education and income exhibited the lowest decrease in the prevalence of periodontitis compared with their White and Mexican-American counterparts.

When studying periodontitis, one of the major conundrums is the case definition to be used because there is no standard definition. The prevalence of periodontitis thus depends on the definition used. Previous stud-

ies have used several combinations of CAL and PD to establish periodontitis case definitions.<sup>25,27,32–34</sup> The rationale behind CAL and PD combinations is that CAL represents a cumulative measure of periodontal tissue destruction throughout life, whereas PD indicates the presence of active disease.<sup>15,33</sup> For this study, we tested several case definitions based on different combinations of PD and CAL. All the definitions tested led to the same conclusion: Blacks exhibited twice the prevalence of periodontitis as Whites, whereas Mexican Americans exhibited a prevalence intermediate between those for Blacks and Whites. Therefore, it is very unlikely that our results would vary if a different case definition was used in the study.

Previous studies have shown that people with low SES exhibit a higher prevalence of periodontitis than their high-SES counterparts, regardless of the SES indicator used. This finding has been consistently reported across racial/ethnic groups.<sup>19–25</sup> Our study, although somewhat consistent with previous studies, shows that the relationship between the prevalence of periodontitis and income and education is different across racial/ethnic groups. When compared with Whites and Mexican Americans, Blacks exhibited the highest prevalence of periodontitis independent of their education, whereas high-income Blacks exhibited the highest prevalence of periodontitis. Mexican Americans exhibited the lowest prevalence of periodontitis regardless of their income and education. When evaluating the contribution of SES on racial/ethnic health differences, some studies suggest that SES could be an important factor in explaining the existing racial/ethnic health differences,<sup>47–49</sup> whereas other studies underscore measurement problems when evaluating the effect of SES on health.<sup>7,50–53</sup> The latter explanation is because of the incommensurability of SES across racial/ethnic groups, measurement error, and devaluation of particular racial/ethnic groups' SES resources (for example, housing equity is a major source of wealth. However, Blacks tend to receive smaller returns on their real state investment than Whites). Our findings that Blacks received the lowest benefit from the SES indicators on periodontal health could be a combination of the aforementioned factors or perhaps an indication of how far, in

**TABLE 3—Prevalence and Prevalence Ratios of Periodontitis and 95% Confidence Intervals for the Independent and Joint Effect of Income and Education for Each Racial/Ethnic Group: Third National Health and Nutrition Examination Survey, 1988–1994**

	Prevalence of Periodontitis								
	Black (B)		Mexican American (MA)		White (W)		Adjusted Prevalence Ratios		
	Unadjusted	Adjusted <sup>a</sup>	Unadjusted	Adjusted	Unadjusted	Adjusted	B:W	B:MA	MA:W
Overall	14.2 (11.3–17.1)	6.9 (4.4–9.4)	9.4 (6.4–12.4)	3.0 (1.5–4.5)	5.3 (4.0–6.5)	5.2 (3.8–6.5)	1.33 (1.27–1.38)	2.30 (2.21–2.39)	0.57 (0.56–0.59)
<b>Independent effect</b>									
Education, y									
< 12	16.8 (12.7–20.9)	15.2 (9.1–21.3)	11.9 (8.2–15.6)	7.0 (4.3–9.7)	10.4 (7.2–13.6)	5.9 (3.5–8.3)	2.58 (2.37–2.80)	2.14 (1.96–2.34)	1.20 (1.14–1.27)
≥ 12	11.5 (7.8–15.4)	10.2 (6.5–13.9)	3.6 (1.0–6.2)	2.2 (–0.1–4.5)	4.0 (2.8–5.2)	4.4 (3.0–5.8)	2.32 (2.20–2.44)	4.86 (4.57–5.16)	0.48 (0.46–0.49)
Income									
< \$20 000	17.8 (14.0–21.5)	10.7 (6.1–15.3)	13.2 (9.0–17.4)	5.2 (2.2–8.2)	10.0 (6.4–13.6)	8.2 (5.1–11.2)	1.30 (1.21–1.41)	2.06 (1.96–2.15)	0.63 (0.60–0.67)
≥ \$20 000	11.5 (7.6–15.4)	13.9 (9.3–18.4)	3.9 (1.1–6.7)	5.1 (1.8–8.6)	3.6 (2.3–4.9)	3.7 (2.4–5.0)	3.76 (3.56–3.97)	2.72 (2.54–2.92)	1.38 (1.31–1.45)
<b>Joint effect<sup>b</sup></b>									
Low education–low income	17.6 (13.2–22.0)	13.4 (8.2–18.6)	13.4 (9.1–17.7)	7.2 (2.5–11.8)	13.0 (7.8–18.3)	9.3 (5.7–12.8)	1.44 (1.32–1.57)	1.86 (1.69–2.5)	0.77 (0.71–0.84)
Low education–high income	17.6 (7.6–27.6)	16.4 (6.5–26.3)	7.9 (2.0–13.7)	7.0 (2.5–11.5)	6.8 (2.3–11.3)	5.3 (2.1–8.5)	3.09 (2.71–3.53)	2.34 (2.03–2.70)	1.32 (1.22–1.43)
High education–low income	18.3 (10.4–26.1)	8.2 (1.8–14.5)	12.2 (1.4–23.0)	1.9 (–0.8–4.6)	7.8 (3.8–11.8)	8.3 (4.1–12.5)	0.99 (0.89–1.10)	4.31 (3.94–4.72)	0.23 (0.21–0.24)
High education–high income	8.9 (5.0–12.8)	11.6 (7.2–16.0)	1.2 (–0.4–2.8)	2.1 (–0.8–5.0)	3.2 (2.0–4.4)	3.4 (2.1–4.7)	3.41 (3.22–3.61)	5.52 (5.13–5.94)	0.61 (0.59–0.64)

<sup>a</sup>Prevalences were estimated from logistic regression models adjusting for age (categorical), gender, presence of health insurance, time since last dental visit, history of diabetes, and smoking. The prevalences for each racial/ethnic group are adjusted for income level and education level. The prevalences of periodontitis in education for each racial/ethnic group are adjusted for income and vice versa (i.e., periodontal prevalences for income level are adjusted for education level).

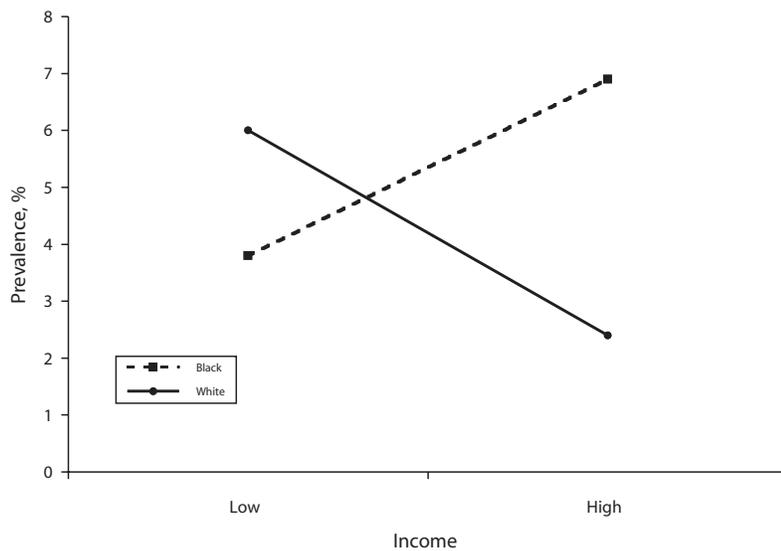
<sup>b</sup>These categories are cross-classified categories of income (< \$20 000 vs ≥ \$20 000) and education (< 12 years vs ≥ 12 years) for each racial/ethnic group.

general, Blacks lag behind their White counterparts to begin with. Although Blacks and Whites exhibited an opposite relation between the prevalence of periodontitis and income, the gap between Blacks and Whites was wider at higher income levels than at the lower levels. This finding could suggest different mechanisms by which income influences periodontal health for each racial/ethnic group and perhaps could reflect the incommensurability of income across racial/ethnic groups. Moreover, there is evidence that SES indicators do not carry the same meaning across racial/ethnic groups, leading to residual confounding.<sup>50,52</sup> This residual confounding could then translate into the observed racial/ethnic differences in periodontal disease.

The association between income and the prevalence of periodontitis was modified by race/ethnicity. The estimate of this interaction

remained nearly unchanged when education was either excluded or included as a 3- or 4-category specification instead of 2 categories in the model (data not shown). These findings suggested that residual confounding by education is an unlikely explanation for this interaction and that the effect of the interaction was independent of education. This interaction, although intriguing because it goes against the common inverse relation between SES indicators and most health outcomes reported by most studies,<sup>3,5,7</sup> could help our understanding of the effect of the SES-race/ethnicity association on periodontal health. Very little is known regarding how SES factors operate within each racial/ethnic group, and research in this area could help our understanding regarding the differences between racial/ethnic groups that may contribute to oral health disparities in general.

Although most of the existing evidence suggests an inverse association between SES and periodontal diseases,<sup>18–24</sup> and health outcomes in general,<sup>3,5,7</sup> a few studies suggest that the social conditions in which groups are embedded could determine different levels of exposure to stress, which then could affect health.<sup>54–57</sup> Based on these studies, it is possible that high-income Blacks experienced a higher level of stress trying to cope with their everyday demands. This stress, associated with, and perhaps increased by, other circumstances such as racism<sup>58–60</sup> could translate into a higher prevalence of periodontal disease. For example, studies of periodontal health have found an association between periodontitis and stressors related to work,<sup>61</sup> stressful life events,<sup>62</sup> and psychosocial factors.<sup>63</sup> Recently, Genco and colleagues reported that psychosocial measures of stress



Note. Interaction obtained from a model with race/ethnicity as an independent covariates and adjusted for age, gender, education, presence of insurance, time since last dental visit, smoking, and diabetes. Income categories were specified as low (<\$20 000) and high ( $\geq$ \$20 000).

**FIGURE 1—The effect of income on prevalence of periodontitis in Blacks and Whites: Third National Health and Nutrition Examination Survey, 1988–1994.**

were significant risk indicators for more severe periodontal disease in an adult population.<sup>64</sup> Further studies need to be done to help elucidate our understanding of the interplay among SES indicators, stress, and periodontitis among racial/ethnic groups.

By restricting our study to NHANES III participants who received a complete periodontal examination, questions related to the possibility of selection bias due to a healthy or survivor teeth effect are raised. Analysis (not shown) demonstrated that those participants who received a partial examination (i.e., <14 teeth examined) exhibited a lower prevalence of periodontitis ( $P<.001$ ) than their peers with a complete examination. However, there were no differences among racial/ethnic groups between those who received a partial examination and those who received a complete examination ( $P=.3273$ ). In addition, when compared with those with a complete examination, the racial/ethnic pattern of the prevalence of periodontitis for those with partial examinations was similar to the one presented in our results. Finally, this restriction could question the direct association between income and periodontitis observed in Blacks. However, we repeated the analysis including both Blacks with a complete and a partial pe-

riodontal assessment, and the direct association persisted, although not with the same magnitude (10.4% for low income vs 11.7% for high income). Because of the age range of our study population, exclusions for medical reasons were also a concern. Analysis (not shown) indicated that there was no statistically significant association between medical exclusion and (1) race/ethnicity ( $P=.06$ ) and (2) education ( $P=.13$ ). However, there was an association between medical exclusion and income, with those with low incomes being more likely to be excluded ( $P=.01$ ).

The major limitation of the study was its cross-sectional nature, which limited our ability to establish a causal relationship. However, this study has several strengths that include (1) the racial/ethnic diversity and representativeness of the sample, and (2) the age range included in our analysis, which included people who had achieved possibly the highest level of education they would attain during their lifetime. This educational attainment has a stabilizing effect on income.

Our findings suggest that Blacks demonstrated a lower decrease in the prevalence of periodontitis across the education and income categories than their Mexican-American and White peers. These findings could confirm the

incommensurability of SES indicators across racial/ethnic groups and perhaps could reflect the historical implications of unequal opportunities for Blacks in our society. Therefore, our findings call attention to the importance of recognizing SES health differences across racial/ethnic groups within our social, political, and historical context. It is clear that race/ethnicity and SES indicators are intertwined in explaining the health status, including the oral health, of the US population. However, studies in this area are far from conclusive, and many questions remain unanswered. As we move forward to reduce and eliminate health disparities, we must do better to disentangle and to explain these differences using a framework that accounts for the implications of social constructs such as race/ethnicity on the health of the US population. ■

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#### Contributors

L.N. Borrell planned the study, analyzed the data, and wrote the article. B.A. Burt, H.W. Neighbors, and G.W. Taylor contributed to interpreting the analyses and reviewing and writing the article.

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#### Human Participant Protection

The data were collected with the informed consent of the respondents following procedures approved by the institutional review board of the National Center for Health Statistics. In addition, the analysis was approved by the institutional review board at Columbia University.

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# Oral Disease Burden in Northern Manhattan Patients With Diabetes Mellitus

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Periodontal diseases are bacterially induced chronic inflammatory diseases affecting the tissues surrounding and supporting the teeth. The lesion begins as gingivitis, an inflammation of the gingival tissues only, and may progress to periodontitis, where destruction of connective tissue attachment and alveolar bone can eventually lead to tooth loss. In 1993, periodontitis was referred to as the sixth complication of diabetes mellitus<sup>1</sup>; in the 1997 report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, it was cited as one of the pathological conditions often found in patients with diabetes.<sup>2</sup> Indeed, multiple studies have provided conclusive evidence that the prevalence, severity, and progression of periodontal disease are significantly increased in patients with diabetes.<sup>3</sup> Other oral complications have been reported in patients with diabetes, such as caries, xerostomia, and mucosal lesions. However these associations are weaker, and conflicting data have been reported.<sup>4–8</sup>

If left untreated, periodontitis can lead to tooth loss, thereby compromising a patient's ability to maintain a proper diet and affecting the quality of life. Furthermore, longitudinal studies have reported that severe periodontal disease in diabetic patients at baseline is associated with poor metabolic control and other diabetic complications at follow-up.<sup>9,10</sup> There also has been a suggestion in the literature that mechanical periodontal therapy in conjunction with systemic antibiotics may result in improved metabolic control in some patients with diabetes, especially those with poor metabolic control and severe periodontitis at baseline.<sup>11</sup>

As previous studies have reported an overall high degree of agreement between radiographic and clinical assessments of destructive periodontal disease,<sup>12</sup> we explored the association between oral/periodontal disease and diabetes using dental and radiographic records of patients seen at the Comprehen-

**Objectives.** We explored the association between diabetes mellitus and oral disease in a low-socioeconomic-status urban population.

**Methods.** Dental records of 150 adults with diabetes and 150 nondiabetic controls from the dental clinic at Columbia University in Northern Manhattan matched by age and gender were studied.

**Results.** There was a 50% increase in alveolar bone loss in diabetic patients compared with nondiabetic controls. Diabetes, increasing age, male gender, and use of tobacco products had a statistically significant effect on bone loss.

**Conclusions.** Our findings provide evidence that diabetes is an added risk for oral disease in this low-income, underserved population of Northern Manhattan. Oral disease prevention and treatment programs may need to be part of the standards of continuing care for patients with diabetes (*Am J Public Health*. 2004;94:755–758)

sive Care Clinic at Columbia University School of Dental and Oral Surgery. Most individuals served by this clinic, and included in this retrospective case–control study, reside in Northern Manhattan. The Northern Manhattan communities of Washington Heights/Inwood and Harlem had a population of 500 000 in 2000; residents' incomes were among the lowest in New York City.<sup>13</sup> An estimated 34% of this population was living at or below the federal poverty level as of 1990, and Northern Manhattan is identified as a Medical and Dental Health Manpower Shortage Area by the Health Resources Services Administration of the Department of Health and Human Services. Forty-nine percent of the residents are Hispanic (mostly of Dominican origin), 44% are African American, and the balance represents other ethnic/racial groups.<sup>14</sup>

## METHODS

### Study Population

Data on 300 dentate adults were included in this study. Dental records for 150 people aged older than 18 with diabetes mellitus seen at the Comprehensive Care Clinic at Columbia University School of Dental and Oral Surgery in Northern Manhattan were selected

at random. Dental records with a full-mouth series of intraoral radiographs taken during a 3-year period (1999–2001) were used. The selection process involved reviewing the recorded medical history to identify a positive history for diabetes. The age range of the diabetic patients was 20 to 88 years. The records of a control group of 150 nondiabetic patients were then chosen. Control subjects were matched by gender and age ( $\pm 5$  years) to the case group. The age range of the nondiabetic subjects was 18 to 90 years.

The following general patient information was identified from the chart and recorded: age at the time of the radiographic examination, gender, and ethnicity (Hispanic or non-Hispanic). No information on race was available in the dental records. The subjects' tobacco use habits and pregnancy status also were recorded. In addition, for the diabetic group, type of diabetes (type 1, type 2, or unknown) and mode of therapy (insulin, oral hypoglycemic agent, both, or unknown) were noted.

### Radiographic Examination and Assessments

Full-mouth periapical and posterior bite-wing radiographs for all patients were evaluated by a single examiner (D.B.P.). All linear

measurements, performed with a ruler, were rounded to the nearest whole millimeter. Sites where excessive radiographic distortion existed or where either the cemento-enamel junction (the junction of the crown and root of the tooth) or alveolar bone crest were unidentifiable were recorded as “nonreadable” and excluded from the analysis. The following parameters were determined:

- *Missing teeth*: the number of missing teeth based on a complete dentition of 32 teeth.
- *Alveolar bone level*: the distance in millimeters from the cemento-enamel junction to the most coronal level along the distal and mesial root surface at which the periodontal ligament space was considered to have a normal width.<sup>15</sup> Thus, an increased value translates into increased alveolar bone loss.
- *Root length*: the distance from the cemento-enamel junction to the radiographic apex of the tooth along the distal and mesial root surface of the tooth.
- *Proportional bone loss*: the ratio of the alveolar bone level minus 2 to the root length minus 2 was calculated for the distal and mesial surface of each tooth (in healthy periodontal tissues, the alveolar bone crest is approximately 2 mm apical to the cemento-enamel junction).
- *Furcation involvement*: the number of multirooted teeth with radiolucency between the roots, suggesting interradiolar bone destruction.
- *Cariou lesions*: the number of teeth with radiolucencies extending into the dentin.
- *Periapical radiolucencies*: the number of teeth with radiolucencies around the apex, indicative of necrosis of pulpal tissue and an inflammatory response at the root tip.
- *Endodontic treatment*: the number of teeth with radiographic evidence of endodontic treatment (obturation of the root canal with radio-opaque material).
- *Restorations and fixed prostheses*: the number of teeth with radiographic evidence of amalgam restorations and crowns, respectively.

#### Error of the Method

The error inherent in the linear measurements was evaluated by repeated measurements. Specifically, in a subsample of 100 individuals, 50 with diabetes and 50 nondiabetic, measurements of alveolar bone level

were repeated on a second occasion by the same examiner. The mean difference between the first and second measurement for alveolar bone level was 0.6 mm (SD=0.7). At 44.4% of the sites, the double measurements were identical. Reproducibility within 1 mm was 88.4%; within 2 mm it was 98.1%, and within 3 mm it was 99.3%.

The error inherent in the method by which the radiographs were obtained and evaluated also was assessed through the root length measurements as follows: for all teeth, except molars, the 2 root length measurements were averaged and used in the calculation of the mean root length per tooth type. These values were compared with published root length data obtained from measurements on extracted teeth. The radiographically assessed root length was similar to the data reported by Wheeler<sup>16</sup> on extracted teeth: for 14 of the 18 measurements, the difference was less than 1 mm. The biggest differences were noted in maxillary second molar and mandibular premolar measurements, similar to what has been reported previously<sup>17</sup>; they seem to be mostly related to the technique used to obtain dental radiographs.

#### Statistical Analysis

The Statistical Analysis System package (SAS Institute Inc, Cary, NC) was used for calculating mean values, standard deviations, and frequencies, as well as for performing Student *t* tests and multiple regression analyses. *P* values of less than .05 were considered statistically significant.

## RESULTS

The case and control group each consisted of 93 females (62%) and 57 males (38%). None of the females in either group was pregnant. In the diabetic group, 103 subjects (69%) were Hispanic and 47 (31%) were non-Hispanic. In the control group, 90 subjects (60%) were Hispanic and 60 (40%) were non-Hispanic. The mean age in the diabetic group was 56.1 ±13.1 years versus 55 ±14.2 years in the control group. Twenty-three (15%) of the cases, versus 25 (17%) of the controls, had reported that they were cigarette smokers, were using some other tobacco product, or both.

Of the 150 patients with diabetes, 23 (15%) were type 1, 103 (69%) were type 2, and 24 (16%) did not know their type and we were unable to retrieve this information from other chart entries. Forty-two (28%) of the diabetic patients were on insulin, 94 were (63%) on 1 or more oral hypoglycemic agents, 10 (7%) were on both, and 5 (3%) were on a diet/exercise regimen only. There was no relevant information for 10 (7%) of the diabetic individuals in the group.

Table 1 shows the radiographic findings in our study population. The mean number of missing teeth per patient was 10 ±6.6 in the control group and 11.5 ±6.8 in the diabetic group. This difference approached, but did not reach, statistical significance (*P*=.06). However, alveolar bone loss was significantly greater in the diabetic group than in the control group (mean alveolar bone level=4.0 ±1.9 mm and 3.1 ±1.4 mm, respectively; *P*=

**TABLE 1—Radiographic Findings in Study Population of Diabetic Cases and Nondiabetic Controls in Northern Manhattan**

	Nondiabetic (n = 150)	Diabetic (n = 150)	<i>P</i>
Missing teeth	10 (6.6)	11.5 (6.8)	.06
Mean alveolar bone level, mm	3.1 (1.4)	4.0 (1.9)	<b>.0001</b>
Mean proportional bone loss, %	6.0 (5.0)	9.0 (7.0)	<b>.0001</b>
Teeth with furcation involvement	0.5 (1.3)	0.5 (1.1)	.9999
Cariou teeth	2.2 (2.2)	2.4 (2.4)	.4
Teeth with periapical pathology	0.4 (1.0)	0.4 (0.7)	.6
Teeth with restorations and fixed prostheses	8.5 (5.4)	6.7 (5.4)	<b>.005</b>
Teeth with endodontic treatment	1.0 (1.8)	0.6 (1.2)	<b>.02</b>

Note. Values given are means and standard deviations (in parentheses). *P* values in boldface are statistically significant.

.0001). Proportional bone loss was 50% higher in the diabetic group ( $0.09 \pm 0.07$ ) than in the control group ( $0.06 \pm 0.05$ ;  $P = .0001$ ). The mean number of teeth with radiographic evidence of furcation involvement per subject in both the control and the diabetic group was 0.5 ( $\pm 1.3$  and  $\pm 1.1$ , respectively;  $P = .9999$ ).

Interestingly, although the mean number of teeth with carious lesions was similar in controls and cases ( $2.2 \pm 2.2$  and  $2.4 \pm 2.4$ , respectively;  $P = .4$ ), the control group had significantly more teeth with restorations and fixed prostheses than the diabetic group ( $8.5 \pm 5.4$  and  $6.7 \pm 5.4$ , respectively;  $P = .005$ ). Similarly, although the mean number of teeth with periapical radiolucencies per patient in the control group ( $0.4 \pm 1.0$ ) was comparable to that in the diabetic group ( $0.4 \pm 0.7$ ;  $P = .6$ ), the control group had significantly more endodontically treated teeth than the diabetic group ( $1.0 \pm 1.8$  and  $0.6 \pm 1.2$ , respectively;  $P = .02$ ).

To identify some of the determinants of alveolar bone destruction in our study population (both cases and controls), a multiple regression model using diagnosis of diabetes, age, gender, and cigarette smoking/tobacco product use as the independent variables was constructed. Of particular significance, the model revealed that, in this population, diabetes, increasing age, male gender, and smoking/use of tobacco products had a statistically significant effect on bone loss, with age and diabetes being the most important determinants (Table 2). Multiple regression for alveolar bone destruction in the cases included (in addition to the variables above) only type of diabetes and type of diabetes regimen (insulin vs oral agent) as independent variables. This model also revealed increasing age, male gender, and smoking as statistically significant determinants of bone loss.

## DISCUSSION

Our findings in this Northern Manhattan population confirm previous evidence that diabetes mellitus is associated with increased severity of periodontal destruction. Our study cohort represents a low-income, underserved, mostly Hispanic population. Recent studies in children and seniors from this population

**TABLE 2—Multiple Regression Analysis of Study Population of Diabetic Cases and Nondiabetic Controls in Northern Manhattan**

Independent Variable	Regression Coefficient	P	Squared Part Correlation
Diabetes <sup>a</sup>	0.8930	.0001	0.073
Age	0.0447	.0001	0.107
Gender <sup>b</sup>	-0.5604	.0021	0.034
Smoking/tobacco product use <sup>c</sup>	0.8845	.0003	0.035

Note. The dependent variable was alveolar bone level.  $R^2 = 0.25$ .

<sup>a</sup>0 = no, 1 = yes.

<sup>b</sup>0 = male, 1 = female.

<sup>c</sup>0 = no, 1 = yes

have reported that, compared with national standards, the oral disease burden in Northern Manhattan is high.<sup>18–20</sup> In such communities, inability to afford care and limited access to dental services are likely to lead to high levels of oral disease. Diabetes then becomes an added risk in a population already at risk for oral disease. Indeed, although evidence of periodontal destruction and tooth loss was present in the control group of nondiabetic individuals, diabetes clearly conferred an increased risk.

In our multiple regression model for the whole study population, diabetes, age, male gender, and use of tobacco products were identified as significant determinants of bone destruction. For the diabetic group only, the same 3 variables also had a statistically significant effect on bone loss, which is in agreement with what is well established for periodontal destruction in the general population.<sup>21</sup> Furthermore, there was a trend for an increased number of missing teeth in the individuals with diabetes, but the difference only approached statistical significance ( $P = .06$ ). It is important to remember that tooth loss reflects not only a history of severe periodontal destruction but also the accumulated effects of advanced caries and endodontic infections. In patients with limited resources living in underserved areas, teeth with even moderately advanced dental problems are often extracted rather than restored or endodontically treated.

Of importance is the finding that although the caries rate and presence of periapical pathology were similar in the case and control groups, diabetic patients had fewer teeth previously treated for these conditions. In a recent report,<sup>22</sup> patients with diabetes were less likely than those without diabetes to have seen a dentist within the past year; this difference was statistically significant even after age, race/ethnicity, education, income, and dental insurance coverage were adjusted for. Interestingly, the primary reason for not seeing a dentist given in that study was lack of a perceived need.

The etiopathogenesis of periodontitis is complex, and evidence is accumulating that a wide range of factors are probably responsible for the increased risk of periodontal disease observed in diabetes. Impaired recruitment and function of neutrophils, upregulated pro-inflammatory monocyte response to pathogenic bacteria, impaired collagen synthesis, exaggerated collagenolytic activity, and genetic predisposition are all factors that have been implicated.<sup>23–25</sup> Work from our group has suggested a role for RAGE (receptor of advanced glycation end products) activation in this setting. Blockade of RAGE resulted in suppression of alveolar bone loss and of markers of inflammation/tissue destruction in diabetic mice infected with a periodontal pathogen, providing novel insights into the mechanisms underlying the association between diabetes and oral disease.<sup>26</sup>

Importantly, evidence of an effect of oral/periodontal infections on systemic health has accumulated in recent years. This includes an effect on the level of metabolic control in diabetic individuals<sup>11</sup> and an increased risk for cardiovascular and cerebrovascular events.<sup>27,28</sup> In combination with the increased risk of vascular disease associated with diabetes mellitus, this highlights another reason for referral of patients with diabetes for dental evaluation and treatment.

Currently, treatment guidelines of the Centers for Disease Control and Prevention recommend that people with diabetes see a dentist at least every 6 months, and more frequently if they are diagnosed with periodontal disease. However, in the American Diabetes Association position statement on standards of care for diabetic patients, an oral examination is sug-

gested as part of the initial evaluation but not as a standard of continuing care.<sup>29</sup>

Taken together, our findings provide additional evidence that diabetes is associated with an added risk for periodontal destruction, even in a population already at increased risk for oral disease. Further, our findings corroborate the importance of including oral health information in educational materials and promoting oral prevention/treatment programs for patients with diabetes. ■

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### Contributors

E. Lalla synthesized the analyses and led the writing of the article. D.B. Park collected the data and performed all radiographic measurements. P.N. Papapanou assisted with the study and conducted the data analyses. I.B. Lamster conceived the study and supervised its implementation. All authors helped to interpret findings and reviewed drafts of the article.

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### Human Participant Protection

No protocol approval was needed for this study at the time it was conducted.

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# Dental Insurance Visits and Expenditures Among Older Adults

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As they age, adults are retaining a higher mean number of teeth, potentially increasing their dental needs at a time when they may also be experiencing a diminished capacity to access care because of retirement and its attendant loss of income and dental coverage. The oldest age groups are the fastest growing segments of the US adult population. Although the total US population is expected to increase by 42% over the next half century, the number of men and women aged 65 years and older will increase by 126%, those aged 85 and older will increase by 316%, and centenarians will increase by 956%; nearly 10 times the present number.<sup>1</sup> According to the US Administration on Aging, persons aged 65 years or older totaled 35 million in the year 2000, representing 12.4% of the US population.<sup>2</sup>

At the same time, a growing proportion of US adults are retaining an increasing number of their teeth throughout their life span.<sup>3</sup> A relative increase in coronal and root caries, periodontal diseases, inadequate or absent prostheses, and preventive needs may result from a greater number of retained teeth among elderly persons.<sup>4</sup> Additionally, because oral and pharyngeal cancers are diagnosed primarily among older Americans, as the population ages, the number of persons benefiting from early diagnosis will also increase.<sup>5</sup>

Paradoxically, as the number of people with dental care needs increases, for many aging Americans, the ability to finance this care may actually be decreasing as a result of retirement. Retirement is generally accompanied by a decrease in income and the loss of employer-sponsored dental coverage.<sup>6,7</sup> Although Medicare is usually available to retirees to cover many, if not most, health care needs, dental care is rarely covered. The purpose of this article is to examine the confluence of an aging population, decreased income, and a decreased availability of dental care coverage using data from the 1996 Medical Expenditure Panel Survey (MEPS).<sup>8</sup>

**Objectives.** We examined the effect of age, income, and coverage on dental service utilization during 1996.

**Methods.** We used data from the 1996 Medical Expenditure Panel Survey.

**Results.** Edentulous and poorer older adults are less likely to have coverage and less likely to report a dental visit than dentate or wealthier older adults.

**Conclusions.** These analyses help to describe the needs of older adults as they cope with diminishing resources as a consequence of retirement, including persons previously accustomed to accessing oral health services with dental insurance. (*Am J Public Health.* 2004;94:759–764)

## METHODS

We focused on utilization of dental care services among older adults and the effect of income and coverage associated with dental care use during 1996 for the US noninstitutionalized population. We used data from the 1996 MEPS, a nationally representative health survey of the US noninstitutionalized population sponsored by the Agency for Healthcare Research and Quality. Specifically, national estimates are provided for income (poverty status), the percentage with dental coverage, and the percentage of the older adult population that visited a dentist during 1996.

We conducted multivariate analyses to measure the effect of income and age associated with dental coverage status after control for various socioeconomic and demographic variables. In addition, we conducted multivariate analyses to measure the effect of income, age, and dental coverage status associated with dental care services use, and we controlled for various socioeconomic and demographic variables. The variable for dental coverage indicates whether participants were enrolled in a dental plan or actually received private payments on their behalf for dental care obtained during 1996.

To ensure sufficient numbers to produce reliable national estimates, sociodemographic variable categories were combined when necessary. All estimates and statistics reported

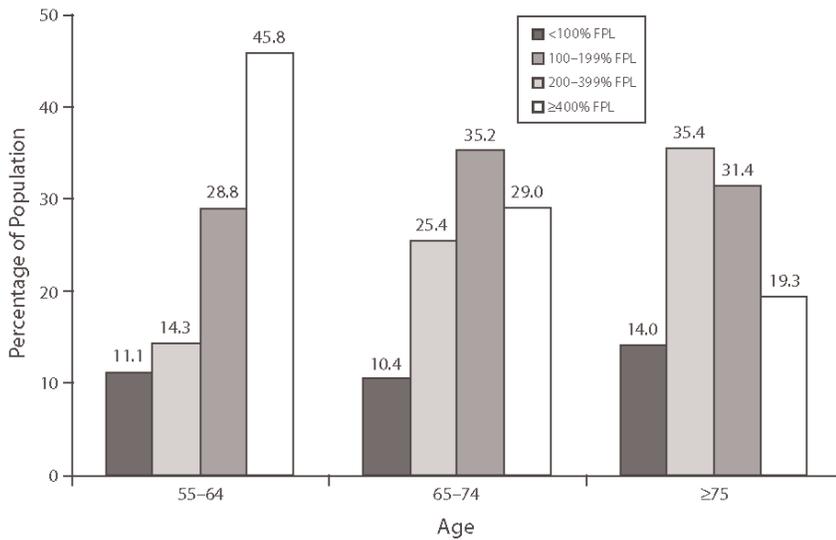
were computed taking into account the complex sampling design of MEPS with the use of the SUDAAN software package.<sup>9</sup>

## RESULTS

There were 4272 participants aged 55 years or older in the 1996 MEPS, representing 54 874 943 noninstitutionalized US adults. Forty-two percent (n=1808) of participants were between the ages of 55 and 64 years, 34% (n=1472) were between the ages of 65 and 74 years, and 27% (n=1167) were aged 75 years or older.

Figure 1 shows the population distribution according to age and family income. Older cohorts were less wealthy than younger cohorts, with a progressively smaller ( $P<.05$ ) percentage of older adults with higher incomes (greater than or equal to 400% of the federal poverty level) and a progressively larger ( $P<.05$ ) percentage with low incomes (100% through 399% of the federal poverty level).

Figure 2 displays the percentage of the population with dental coverage by age. Older cohorts were less likely ( $P<.05$ ) to have dental coverage than younger cohorts. Figure 3 displays the percentage of the population with a dental visit by age. The oldest cohort (aged 75 years or older) was less likely ( $P<.05$ ) to have a dental visit than younger cohorts (aged 55 to 64 years and 65 to 74 years).



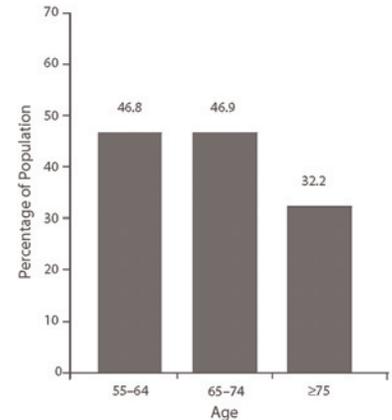
Note. FPL = federal poverty level.

**FIGURE 1—Population distribution by family income and age group.**

Table 1 shows private dental coverage status, the percentage of the population who had made at least 1 dental visit during 1996, the number of visits per person for those who had made a dental visit, and the mean total expenditure for older adults with a dental visit by selected population characteristics. Overall, 34% (n=18 598 065) of all older adults had private dental coverage during 1996. Differences in rates of coverage were noted for the categories race/

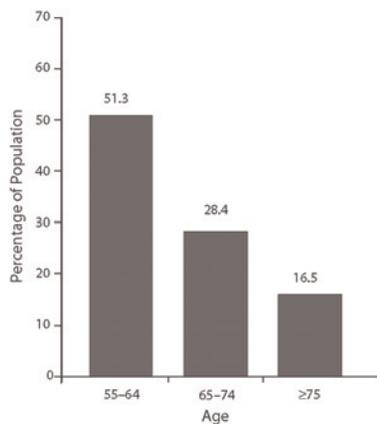
ethnicity, income, age, gender, education, and rural/urban character of county of residence. Overall, 43% (n=23 459 821) of all older adults reported a dental visit during 1996. The mean total expenditure for those with expenditures was \$428, and the mean number of visits for those with a visit was 2.88. Differences in the likelihood of a visit were noted for the categories presence of teeth, dental insurance coverage, race/ethnicity, income, age, education, and rural/urban character of county of residence. For those with a visit, less variation was observed in the mean number of visits and mean expenditures than for those without a visit. Surprisingly, although the presence of teeth had a profound effect on the likelihood of a visit, it did not appear to have an effect ( $P>.05$ ) on the mean number of visits or mean expenditures. Coverage and income were both associated with the likelihood of a dental visit, but only coverage appeared to have an effect ( $P<.05$ ) on the mean number of visits or mean expenditures.

Table 2 shows the logistic regression results for the probability of having private dental care coverage (columns 1 and 2) and for the probability of having at least 1 dental visit during the year (columns 3 and 4). Explanatory variables in the coverage equation in the first 2 columns include presence of teeth, gen-



**FIGURE 3—Prevalence of reporting a dental visit during 1996, by age group.**

der, race/ethnicity, family income, education, and metropolitan/nonmetropolitan status. Although the second set of columns in Table 2 includes these explanatory variables, it also includes a dental coverage status variable. Results of the dental coverage equation in the first 2 columns of Table 2 show that persons in older (aged 65 to 74 years and 75 years and older) cohorts were less likely ( $P<.05$ ) to have coverage than persons in the younger (aged 55 to 64 years) cohort reference group. Results show that older adults with teeth were more likely ( $P<.05$ ) to have coverage than older adults without teeth. Data also show that poor, low-income, and middle-income older adults were less likely ( $P<.05$ ) to have dental coverage than wealthier older adults (reference group=high income). Interestingly, although older Hispanic adults were less likely ( $P<.05$ ) to have coverage, older Black non-Hispanic adults were no less ( $P>.05$ ) likely to have coverage than older White non-Hispanic (reference group) adults. Older male adults (reference group), older college graduate or high school graduate adults, and older adults residing in large or small metropolitan counties were more likely ( $P<.05$ ) to have coverage than older female adults, older adults who did not graduate from high school (reference), and older adults residing in nonmetropolitan counties (reference). Results of the dental use equation in the last 2 columns of Table 2 show that although persons in the middle age



**FIGURE 2—Prevalence of dental insurance coverage, by age group.**

**TABLE 1—Older Adults' Private Dental Coverage, Report of a Dental Visit During 1996, Mean Number of Visits, and Mean Expenditure per User, by Selected Population Characteristics: United States, 1996**

Characteristic	No., Thousands	With Private Coverage, % (SE)	With a Visit, % (SE)	No. of Visits, Mean (SE) <sup>a</sup>	Expenditure, \$, Mean (SE) <sup>a</sup>
Total	54 875	33.73 (1.10)	42.75 (1.15)	2.88 (0.06)	427.70 (18.85)
Dental Coverage					
Covered	18 598	NA	62.58 (1.63)	3.07 (0.09)	498.60 (29.72)
Not covered	36 367	NA	32.66 (1.25)	2.69 (0.09)	358.56 (23.47)
Age, y					
55-64	20 825	51.26 (1.66)	46.82 (1.67)	2.82 (0.08)	413.21 (23.24)
65-74	18 666	28.36 (1.58)	46.90 (1.68)	3.03 (0.12)	454.20 (33.82)
≥ 75	15 384	16.51 (1.34)	32.21 (1.83)	2.73 (0.12)	409.40 (43.37)
Gender					
Female	30 577	29.88 (1.08)	43.36 (1.23)	2.90 (0.07)	439.85 (23.99)
Male	24 298	38.57 (1.45)	41.99 (1.61)	2.84 (0.11)	411.91 (30.21)
Race/ethnicity <sup>b</sup>					
Black non-Hispanic	4 709	25.39 (2.99)	20.99 (2.47)	2.71 (0.22)	434.34 (90.47)
Hispanic	3 130	22.91 (2.74)	28.53 (3.09)	2.70 (0.25)	378.83 (78.70)
White non-Hispanic	47 036	35.28 (1.24)	45.88 (1.29)	2.89 (0.07)	429.42 (19.57)
Education					
College graduate	9 341	51.91 (2.32)	67.40 (2.17)	3.06 (0.12)	449.12 (32.50)
High school graduate	27 410	39.08 (1.40)	47.02 (1.33)	2.90 (0.08)	421.98 (23.55)
Some or no school	17 967	16.34 (1.31)	23.58 (1.43)	2.54 (0.15)	415.72 (58.51)
Family income <sup>c</sup>					
Poor	6 389	13.18 (1.75)	25.12 (1.90)	2.68 (0.20)	366.14 (48.15)
Low	13 170	15.62 (1.45)	29.80 (1.76)	2.80 (0.13)	343.28 (27.31)
Middle	17 396	36.26 (1.85)	43.45 (2.03)	2.91 (0.13)	474.57 (46.70)
High	17 920	51.91 (1.81)	57.88 (1.61)	2.92 (0.09)	435.02 (24.61)
Teeth					
Has teeth	41 117	38.55 (1.24)	53.02 (1.25)	2.88 (0.06)	423.97 (19.71)
Has no teeth	13 702	19.24 (1.52)	11.90 (1.11)	2.84 (0.30)	477.67 (54.53)
Rural/urban county <sup>d</sup>					
Large metropolitan	23 853	38.85 (1.49)	44.94 (1.66)	2.88 (0.06)	508.83 (35.51)
Small metropolitan	18 920	34.65 (1.87)	43.46 (2.24)	3.08 (0.10)	384.85 (24.24)
Nonmetropolitan	12 046	22.20 (2.25)	37.50 (2.38)	2.82 (0.11)	313.15 (28.45)

Note. NA = not applicable. Population without private coverage may include persons with public coverage.

<sup>a</sup>For persons with a visit during 1996.

<sup>b</sup>White non-Hispanic includes all other ethnic/racial groups not otherwise included among non-Hispanic Blacks and Hispanics.

<sup>c</sup>Includes persons in families with negative income. *Poor* refers to incomes less than 100% of the poverty line; *low income*, 100% to 199% of the poverty line; *middle income*, 200% to 399% of the poverty line; and *high income* 400% of the poverty line or greater.

<sup>d</sup>*Large metropolitan* refers to urban counties 1 million acres or more in area, *small metropolitan* refers to other metropolitan counties, and *nonmetropolitan* refers to nonmetropolitan counties, whether or not adjacent to urban counties.

cohort (aged 65 to 74 years) were more likely ( $P < .05$ ) to have a visit, persons in the oldest cohort (aged 75 years and older) were not more likely ( $P > .05$ ) to have a visit than persons in the youngest (aged 55 to 64 years) cohort reference group. Data show that poor and low-income older adults were less likely ( $P < .05$ ) to report a dental visit than wealthier

older adults (reference group = high income). Adults with coverage were more likely ( $P < .05$ ) to report a dental visit than older adults without coverage. When we controlled for income, age, and coverage, older Hispanic and Black non-Hispanic adults were less likely ( $P < .05$ ) to have reported a dental visit compared with White non-Hispanic (reference

group) older adults. Women, college graduates, and high school graduates were more likely ( $P < .05$ ) than male (reference) respondents and persons who did not graduate from high school (reference) to report a dental visit. Rural/urban character of county of residence did not affect ( $P > .05$ ) the likelihood of dental care use.

## DISCUSSION

Although these data and analyses are useful, they do have limitations. For instance, self-reporting of data is less accurate than collection by observation or by dental record abstraction, and analyses of data from different survey sources has historically resulted in national estimates that vary.<sup>10</sup> Also, the cross-sectional MEPS may be subject to cohort effects that may limit any longitudinal inferences made. In addition, the specification of the dental coverage variable is a function of both a report of coverage and a report of payment for dental care by a third party. Also, the age at which persons retire or become eligible for Social Security is variable. An increasing number of people are expected to delay retirement until they are between 67 and 70 years old rather than the customary age of 65 years. Finally, individual coverage plans may vary considerably in their degree of benefit generosity.

On the other hand, these data are useful, are comprehensive, and provide estimates that are nationally representative. As such, MEPS data are unique and provide important information from which dental coverage and visits can be compared in the context of age and income. Additionally, although the specification for dental coverage has limitations, its formulation is based on previously used and accepted methods, provides an acceptable nationally representative measure of dental care coverage, and makes possible valuable analyses and comparisons.<sup>11</sup>

Analysis of MEPS data yields results supporting findings reported elsewhere in the literature regarding the use of oral health care services by adults aged 65 years and older. Older age cohorts were found in this study to be less wealthy, more likely to have fewer teeth, less likely to have dental insurance coverage, and ultimately less likely to have a dental visit than younger age cohorts.

**TABLE 2—Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) for Predictors of Private Dental Coverage and a Dental Visit During 1996: United States, 1996**

Characteristic	Predictors of Dental Coverage AOR <sup>a</sup> (95% CI)	Predictors of a Dental Visit AOR <sup>a</sup> (95% CI)
Dental coverage		
Covered	... ..	2.53 (2.08, 3.07)
Not covered	... ..	1.00 ...
Age, y		
55–64	1.00 ...	1.00 ...
65–74	0.42 (0.35, 0.50)	1.71 (1.40, 2.09)
≥ 75	0.25 (0.20, 0.32)	1.09 (0.85, 1.39)
Gender		
Female	0.80 (0.71, 0.91)	1.50 (1.28, 1.75)
Male	1.00 ...	1.00 ...
Race/ethnicity <sup>b</sup>		
Black non-Hispanic	0.82 (0.61, 1.04)	0.38 (0.26, 0.55)
Hispanic	0.59 (0.41, 0.85)	0.58 (0.41, 0.82)
White non-Hispanic	1.00 ...	1.00 ...
Education		
College graduate	2.31 (1.73, 3.09)	3.18 (2.51, 4.04)
High school graduate	1.93 (1.56, 2.37)	1.68 (1.38, 2.03)
Some or no school	1.00 ...	1.00 ...
Family income <sup>c</sup>		
Poor	0.24 (0.17, 0.34)	0.55 (0.43, 0.71)
Low	0.35 (0.27, 0.45)	0.68 (0.53, 0.86)
Middle	0.80 (0.65, 0.99)	0.82 (0.66, 1.02)
High	1.00 ...	1.00 ...
Teeth		
Has teeth	1.57 (1.23, 1.99)	6.50 (5.12, 8.26)
Has no teeth	1.00 ...	1.00 ...
Rural/urban county <sup>d</sup>		
Large metropolitan	2.07 (1.52, 2.81)	0.93 (0.72, 1.20)
Small metropolitan	1.77 (1.27, 2.46)	0.99 (0.75, 1.30)
Nonmetropolitan	1.00 ...	1.00 ...

Note. Population without private coverage may include persons with public coverage.

<sup>a</sup>A given odds ratio is adjusted for all the other variables in the table.

<sup>b</sup>White non-Hispanic includes all other ethnic/racial groups not otherwise included among non-Hispanic Blacks and Hispanics.

<sup>c</sup>Includes persons in families with negative income. *Poor* refers to incomes less than 100% of the poverty line; *low income*, 100% to 199% of the poverty line; *middle income*, 200% to 399% of the poverty line; and *high income* 400% of the poverty line or greater.

<sup>d</sup>*Large metropolitan* refers to central counties 1 million or more acres in area, *small metropolitan* refers to other metropolitan counties, and *nonmetropolitan* refers to nonmetropolitan counties, whether or not adjacent to urban counties.

It is not surprising to find that the older adults most likely to have dental insurance coverage were also the older adults more likely to have teeth, to be of a younger age cohort, and to be from wealthier families. Women, individuals from metropolitan counties, and high school/college graduates were also more likely to have dental insurance. These results help to establish that the current US oral health care delivery system for older

adults is predominately accessed by dentate individuals with private out-of-pocket means or employer-sponsored insurance coverage.

Another important use of the MEPS data in this study was that it allowed a more detailed analysis of the associations between insurance coverage, presence of teeth, age, income, mean number of visits, and expenditures for various population subgroups. When we controlled for potential confounding variables, our findings

showed that having teeth, being female, being a non-Hispanic White, having higher income, having higher education, and having dental insurance coverage were each associated with an increased likelihood of a dental visit. These findings were not surprising and support those of other studies of US adults.<sup>12</sup> Of the previously mentioned variables, when we controlled for relevant confounding variables, presence of teeth showed the highest odds of a dental visit (adjusted odds ratio=6.5). Our findings also showed that adults just older than the typical retirement age (65 to 74 years) were significantly more likely to visit the dentist than were persons younger than the typical retirement age (55 to 64 years). This association with age, which was revealed when we controlled for confounding variables, was surprising, was not found in the descriptive table, and has not been shown in other national studies. We speculate that utilization may have increased because these individuals perceived that they had a distinct window of time in which they had more free time and more disposable income to receive as many services as needed. But for many postretirement older adults, both the perception and the reality of more disposable income may diminish in time, and the propensity to consume dental benefits could wane.

The importance of these findings and their policy implications become clearer when we ponder a generational cohort effect that is about to take place in the United States. The earliest age cohorts of the “baby boom” generation, comprising approximately 77 million people, or nearly a third of the US population, will be approaching retirement age by 2010, beginning a phenomenon that will only continue over the following 20 years. Although the White-non-Hispanic population aged 65 years and older is expected to grow by 81% between 1999 and 2030, the population of older minorities is expected to grow by 219% during this same time span.<sup>13,14</sup> Other current trends to consider in the future for this burgeoning older adult group include an increase in educational level (the percentage completing high school rose from 28% in 1970 to 70% in 2000), a reduction in overall poverty rates (a historic low for this group was reached in 1999 with a nearly 3% increase for men and 2% increase for women in real income since 1998), a recent rise in life expectancy at the

age of 65 years (an additional 17.9 years), and an approximate 30% decrease in labor force participation since 1968 (17.7% for men aged 65 years and older in 2001).<sup>13,14</sup> Of further concern will be the plight of the increasing number of older persons who will live to the age of 75 and beyond, when it is expected that their long-term needs will accelerate because of disability, limitations in carrying out activities of daily living, and institutionalization.

Further, the burgeoning cohort of baby boomers now reaching old age coincidentally was born at the same time that water fluoridation was widely introduced in the United States in the late 1940s and early 1950s.<sup>15</sup> As a result of this public health measure as well as the introduction and increased use of fluoride dentifrices and other preventive measures, these individuals enter their retirement years with healthier and more teeth than past age cohorts. Edentulism, which is higher in families below the federal poverty line, has declined precipitously over the years, with the most marked decrease found in the oldest age groups.<sup>16</sup> This study demonstrates that dentate status plays a significant role in dental utilization patterns for older adults, with dentate individuals considerably more likely to use the oral health care delivery system than edentate persons. Yet if current trends are maintained, dentate status over time will play a less important role in health service research analyses because of the declining proportion of older adults who will be edentulous.

Our study found that dental insurance coverage also plays an important role in dental care utilization. Perhaps the greatest challenge facing the baby boom generation and the oral health care delivery system will be the loss of employer-sponsored dental insurance subsequent to retirement. A high proportion of this population's access to the dental health care system has been facilitated because of employer-sponsored dental insurance. Consequently, this generation has developed an expectation that its oral health status will be maintained through continued access to oral health preventive and treatment services subsidized by dental insurance plans.

Approximately 22.6 million employees receive employer-sponsored dental insurance, with about 60% of full-time employees at least offered dental benefits by their employ-

ers.<sup>1</sup> These employees generally work in medium-to-large firms and are more likely to be in professional and technical occupations than in blue-collar and service-related jobs.<sup>1</sup> However, this population's effective demand for oral health care achieved in the past may be increasingly compromised in retirement by the loss of these benefits and diminishing personal disposable income.

Our study found that lower-income adults without dental coverage, including individuals from minority groups, are less likely to access dental services than their upper-income peers. This trend would likely extend into retirement years because the prospect of having enough disposable income to pay for dental services would remain low. Further, Medicare does not cover routine dental services, and less than half the states in their Medicaid programs provide preventive and restorative dental services for adults older than 21 years.<sup>17</sup> Unlike coverage for children, Medicaid dental benefits for adults are not mandated; consequently, many of the state Medicaid dental programs covering adults do not provide coverage for those aged 65 years and older, provide only a limited dental benefit schedule, offer low reimbursement for services, and have often been subject to budget cuts or elimination.<sup>17</sup>

Despite the considerable dental needs found in lower-income older individuals, the perceived need may be low and may be a primary explanation, in addition to cost, for the traditionally scant or intermittent patterns of their dental utilization. As this and other studies show, perceived need, want, and related access to dental services may be limited in lower-income individuals, especially those who are partially or totally edentulous.<sup>18,19</sup> Conversely, if a perceived need concerning oral health problems is present, then the potential service demand for this low-income population may be dampened if not diminished by years of poor expectations.

The only elderly retirement age subgroup that would be relatively assured of continued access to dental services would be upper-income adults, who were found in this study to have better access to dental services than low-income subgroups. Assuming that oral health attitudes and behaviors remain steady, it is possible that some in this population

might substitute out-of-pocket payments for care previously paid for by insurance. On the other hand, some upper-income adults might find securing dental care to be more difficult because of a progressive loss of disposable income. As such, additional study is needed to determine the extent to which recent retirees might be willing to pay for care previously covered by insurance.

Middle-income older adults may be the most affected in retirement by the loss of their employer-sponsored dental insurance. Unlike upper-income older adults, middle-income older adults might not have access to sufficient disposable income to afford the cost of dental care. On the other hand, many dentate individuals in this cohort have come to expect to increasingly seek dental services as part of their acquired preventive attitudes and behaviors.<sup>20</sup> Hence, soon after retirement this group may be placed in a position in which it is unable to effectively secure the dental care desired.<sup>21,22</sup> Over time, an increasingly larger proportion of this subgroup may find it difficult to obtain dental care. As such, an increasing inability to pay for dental care may place middle-income older adults at higher risk for undetected oral diseases, including oral and pharyngeal cancers.

Disabled, homebound, and institutionalized older adults will be additionally burdened by a loss of benefits and income. This group tends to spend down any disposable income regardless of economic status because of their disability and need for expensive services. The extent of their oral health care needs and the lack of programs to address these needs are well documented in the literature.<sup>23-26</sup>

Although opportunities to receive dental coverage among retirees are limited, some retirees do have the option of continuing or purchasing postretirement health insurance as an extension of their employer-based health insurance plans. Postretirement coverage is sometimes made available through employer-sponsored postretirement health benefits or limited term continuation coverage such as that provided by the Consolidated Omnibus Budget Reconciliation Act, 1985 (COBRA).<sup>27</sup> Insurance premiums for postretirement health benefits are often employer subsidized and may be generally similar to premiums incurred while an employee.

Conversely, premiums under COBRA, which may provide continuation health insurance coverage for the first 18 months after retirement, are often not employer subsidized and may continue benefits at up to 102% of the nonsubsidized employer group rate. As an upgrade to COBRA, the 1996 Health Insurance Portability and Accountability Act (HIPAA) now extends the ability of employees with health insurance in smaller firms (20 or fewer employees) to have guaranteed purchasing privileges for private individual plans.<sup>27</sup> It also allows workers with expired 18-month COBRA coverage without preexisting health conditions to purchase individual health insurance plans. However, the premiums for all individual private benefit plans are considerably more expensive than those covered under COBRA and may not be available for dental services.<sup>27</sup> For the subgroup of older adults with a higher likelihood of a having a dental visit, an extension of postretirement coverage may provide some older adults some relief as they face this increasing challenge.

More people will be at risk for oral or tooth-specific disease in future age cohorts because teeth are not being lost prematurely and more people are living longer. In a similar vein, studies continue to report lower oral disease rates with each older adult age cohort because of the same improved healthy lifestyles and increased access to dental preventive and treatment regimens that are responsible for the increase in retained teeth. Only older adults from lower socioeconomic backgrounds have not benefited from this cohort effect. Consequently, new dental health care delivery strategies and approaches may be needed to address the changing needs and demographics of this burgeoning population. Further research evaluating the health service needs, demands, and financing of oral health services for older adults and retirees will be helpful, especially in the assessment of those individuals accustomed to accessing oral health preventive and treatment services through dental insurance. Such research also will help the profession better prepare to address needs of the increasing number of baby boomers coping with impending retirement. ■

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### Contributors

R.J. Manski conceived and supervised the study and supervised the analyses. M.D. Macek assisted with the analysis. B.C. Reid and H.S. Goodman assisted with the writing.

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### Human Participant Protection

No protocol approval was needed for this study.

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# Dental Care Use and Self-Reported Dental Problems in Relation to Pregnancy

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One of the Healthy People 2010 objectives is to increase the proportion of adults who use the oral health care system each year.<sup>1</sup> Prevalence rates of dental care use during pregnancy have been reported to range from 23% to 43%.<sup>2,3</sup> Previous studies indicate not only that pregnant women underuse dental care but that poor women disproportionately fail to obtain such care.<sup>2,3</sup>

Although there have been recent increases in research on maternal oral health during and after pregnancy,<sup>4–11</sup> little is known about amenable factors that could be addressed during the prenatal period by maternity care clinicians, dental care providers, public health policymakers, and women themselves. Only 2 studies to date, to our knowledge, have examined predictors of dental care use during pregnancy.

A population-based cross-sectional study conducted in North Dakota revealed that young women, women in poverty, and women with Medicaid coverage were at increased risk of not having a dentist visit during their pregnancy.<sup>3</sup> In another study, Gaffield et al. analyzed Pregnancy Risk Monitoring System data from 4 states.<sup>2</sup> They found a modest increase in risk of dental care underuse associated with poverty, Medicaid coverage, and late-onset prenatal care among women who reported having a dental problem during pregnancy. However, neither of these studies accounted for confounding variables likely to distort the actual relationship between such factors and dental care use.

In 2000, the surgeon general issued a call for action to expand research efforts aimed at improving oral health; this report indicated the need for studies describing the magnitude of the problem, assessing care delivery characteristics, and identifying mitigating factors that promote or hinder good oral health.<sup>12</sup> Many factors associated with dental care use during pregnancy are not amenable to intervention; however, provision of counseling on

**Objectives.** We examined the relationships between risk factors amenable to intervention and the likelihood of dental care use during pregnancy.

**Methods.** We used data from the Washington State Department of Health's Pregnancy Risk Assessment Monitoring System.

**Results.** Of the women surveyed, 58% reported no dental care during their pregnancy. Among women with no dental problems, those not receiving dental care were at markedly increased risk of having received no counseling on oral health care, being overweight, and using tobacco. Among women who received dental care, those with dental problems were more likely to have lower incomes and Medicaid coverage than those without dental problems.

**Conclusions.** There is a need for enhanced education and training of maternity care providers concerning oral health in pregnancy. (*Am J Public Health.* 2004; 94:765–771)

oral health care by maternity care providers is a simple, low-cost intervention.

In addition, increased understanding of mutable factors such as obesity and smoking could offer the potential for developing prenatal screening and referral strategies.<sup>13,14</sup> Clinicians and public health care providers who care for women during pregnancy need new practical information concerning factors that affect dental care use to allow development and implementation of oral health counseling, screening, and referral strategies. The present study was undertaken to examine the association between selected sociodemographic, pregnancy, and health service factors amenable to intervention and the likelihood of dental care use during pregnancy.

## METHODS

Data for this study were derived from the Washington State Department of Health Pregnancy Risk Assessment Monitoring System (PRAMS). The PRAMS surveillance project study methodology has been described in detail previously.<sup>15</sup> Briefly, the study involved a cross-sectional, population-based mail/telephone survey of a stratified systematic sample of Washington mothers who had recently delivered a live-born infant. Washington State birth certificates were the sampling frame source; women from minority racial/ethnic

groups were oversampled. Seventy-four percent of the 2147 women who delivered a live-born infant between January 1 and December 31, 2000, responded to the Washington PRAMS survey (n=1592). Comparisons of birth certificate information among respondents and nonrespondents showed that the latter were more likely to be multiparous, unmarried, and Black and less likely to have completed high school.<sup>16</sup>

In January 2000, several dental care questions were added to the Washington PRAMS survey. The revised survey assessed the care of women's teeth during their pregnancy by asking whether they (1) had needed to see a dentist for a problem, (2) had visited a dentist or dental clinic, or (3) had discussed with a dental or other health care worker how to care for their teeth and gums. Eighty-four percent (n=1343) of the respondents completed all 3 questions on dental care use during pregnancy, and 95% (n=1513) answered 2 of these questions. Information on sociodemographic, prenatal, and health service factors was taken from the PRAMS questionnaire.

We assessed women according to reported absence or presence of self-reported dental problems. Analyses focusing on women with no reported dental problems examined the association between receipt of preventive care and selected risk factors; the goal of analyses focusing on women with reported dental problems separately was to help provide an

understanding of the association between receipt of dental care and selected risk factors. In addition, we examined the association between receipt or nonreceipt of care and reported dental problems to assess the risk factors associated with such problems.

In terms of dental care use variables, women were categorized as follows: (1) those who reported that they had no dental problems yet had received dental care; (2) those who reported that they had no dental problems and did not receive dental care; (3) those who reported that they had dental problems and received dental care; and (4) those who reported that they had dental problems but did not receive dental care. The primary risk factors of interest were household monthly income; participation or nonparticipation in the Special Supplemental Nutrition Program for Women, Infants, and Children; type of prenatal care insurance coverage; trimester in which prenatal care was initiated; prenatal care site; counseling on oral health care; body mass index; smoking status before the pregnancy; smoking status during the final 3 months of the pregnancy; and history of ever having smoked.

We conducted unconditional logistic regression analyses to estimate, by means of odds ratios (ORs), associations between risk factors and dental care use during pregnancy according to self-reported dental problems. We also evaluated the relationship between risk factors and risk of reported dental problems according to receipt or nonreceipt of dental care. Estimates of model parameters were computed via maximum likelihood techniques, and 95% confidence intervals (CIs) were based on coefficient standard errors and the normal approximation.

Established and suggested risk factors were evaluated as potential confounders, including maternal age, marital status, race/ethnicity, educational level, income, parity, body mass index, and smoking status during the final 3 months of pregnancy, along with infant birthweight and estimated gestational age. Those risk factors that resulted in changes of 10% or more in dental care use odds ratio estimates were included in the covariate-adjusted model.

Stata version 7.0 (Stata Corp, College Station, Tex) software was used to account for the complex multistage sampling design implemented to produce population estimates in the modeled analyses. Specifically, individual

PRAMS respondents are assigned an analysis weight that is the product of the sampling weight, the nonresponse weight, and the frame noncoverage weight. Sampling weights are calculated by dividing the number of women in the sample frame for a given stratum by the number of women actually sampled in that stratum. These weights are then adjusted by the response rates and noncoverage rates associated with each stratum.

## RESULTS

Overall, 58% of the pregnant women surveyed here reported receiving no dental care during their pregnancy. Fifteen percent of the respondents reported that they had no dental problems but received dental care; 38% reported that they had no dental problems and did not receive dental care; 26% reported that they did have dental problems and received dental care; and 21% reported that they had dental problems but did not receive dental care. Table 1 shows the distribution of selected sociodemographic, prenatal, and health service characteristics according to self-reported dental problems and receipt of dental care. Women who had no dental problems but received dental care were more likely than women in the other groups to be older, married, White, and primiparous; to be at higher educational and income levels; to have private insurance coverage; and to have received care from a private physician or a health maintenance organization. They were less likely to be obese or to smoke.

We examined the association of potential risk factors with receipt of dental care among women who did not report dental problems during pregnancy and those who did report such problems (Table 2). Among women reporting no dental problems, those who did not receive dental care were at markedly increased risk, relative to those who did receive care, to have not been counseled on oral health care during their pregnancy (OR=22.32; 95% CI=14.22, 35.02) (Table 2).

In addition, among women without dental problems, risk of not receiving dental care was significantly associated with body mass index. The odds ratio among overweight women receiving no dental care was 1.9 (95% CI=1.1, 3.1), and the same odds ratio was observed among obese women who did not receive

dental care (OR=1.9; 95% CI=1.1, 3.3). Among women with no dental problems, measures of smoking appeared strongly associated with risk of not receiving dental care; smoking during the final 3 months of pregnancy was associated with a 3.5-fold increase in risk of not receiving care (95% CI=1.5, 8.1). The results for women who had ever smoked were similar (OR=3.6; 95% CI=1.6, 8.1).

We also examined whether the association between selected risk factors and receipt of dental care during pregnancy varied among the women who reported having dental problems during their pregnancy (Table 2). Nonreceipt of counseling on oral health care during pregnancy was associated with a high risk of not receiving dental care (OR=26.42; 95% CI=12.46, 56.02), and this was the most significant factor of those listed in Table 2. None of the other associations between risk factors and nonreceipt of care were statistically significant.

In an effort to assess risk factors associated with self-identified dental problems during pregnancy, we stratified women according to receipt and nonreceipt of dental care (Table 3). In the analysis involving women who received dental care during their pregnancy, low monthly income (in the \$1200 to \$2099 range) was the factor most strongly associated with an increased risk of reports of dental problems (OR=2.32; 95% CI=1.01, 5.3) (Table 3). The results were similar (2-fold increased risk) among women with Medicaid coverage and among women who reported ever having smoked (OR=2.64; 95% CI=1.13, 6.19). Finally, no measures of selected risk factors were significantly associated with the presence or absence of reported dental problems among the subgroup of women who did not receive dental care during their pregnancy.

## DISCUSSION

In this cross-sectional survey, we identified previously unreported factors potentially amenable to clinical and public health interventions. Among women without reported dental problems, elevated risks of not receiving dental care were associated with not being counseled on oral health care, obesity, and either smoking during the final 3 months of pregnancy or ever having smoked. Obe-

**TABLE 1—Selected Sample Characteristics, According to Dental Care Group:  
Washington State PRAMS Study, 2000**

Characteristic	No Dental Problem/Received Care		No Dental Problem/No Care		Had Dental Problem/Received Care		Had Dental Problem/No Care	
	Sample (n = 374), No. (%)	Weighted Distribution, % <sup>a</sup>	Sample (n = 659), No. (%)	Weighted Distribution, % <sup>a</sup>	Sample (n = 312), No. (%)	Weighted Distribution, % <sup>a</sup>	Sample (n = 168), No. (%)	Weighted Distribution, % <sup>a</sup>
<b>Maternal age, y</b>								
<20	37 (10)	6	78 (12)	10	44 (14)	13	24 (14)	11
20–24	56 (15)	10	178 (27)	23	84 (27)	28	63 (38)	41
25–29	108 (29)	34	190 (29)	31	73 (23)	23	35 (21)	21
30–34	99 (26)	30	139 (21)	23	69 (22)	21	34 (20)	20
≥35	74 (20)	20	74 (11)	13	42 (14)	15	12 (7)	7
<b>Marital status</b>								
Married	285 (76)	84	413 (63)	71	181 (58)	65	81 (48)	59
Unmarried	89 (24)	16	244 (37)	28	127 (41)	33	86 (51)	40
Unknown	0 (0)	0	2 (0)	1	4 (1)	2	1 (1)	1
<b>Race/ethnicity</b>								
White	160 (43)	82	150 (23)	63	67 (22)	59	42 (25)	70
Hispanic	45 (12)	7	126 (19)	16	79 (25)	22	26 (15)	14
Asian/Pacific Islander	76 (20)	6	152 (23)	10	58 (19)	8	28 (17)	7
Black	46 (12)	2	109 (17)	5	51 (16)	4	34 (20)	6
American Indian	43 (12)	1	115 (17)	3	53 (17)	3	38 (23)	3
Unknown	4 (1)	2	7 (1)	3	4 (1)	4	0 (0)	0
<b>Maternal education, y</b>								
<12	33 (9)	5	141 (22)	18	78 (25)	20	29 (17)	13
12	69 (18)	17	180 (27)	27	87 (28)	24	67 (40)	46
>12	246 (66)	72	273 (41)	49	110 (35)	45	57 (34)	34
Unknown	26 (7)	6	65 (10)	6	37 (12)	11	15 (9)	7
<b>Washington income, \$ (monthly)</b>								
<1200	49 (13)	11	168 (26)	22	96 (31)	25	75 (45)	38
1200–2099	59 (16)	12	173 (26)	24	96 (31)	31	41 (24)	24
2100–2999	48 (13)	13	83 (12)	14	31 (10)	14	19 (11)	18
≥3000	218 (58)	64	235 (36)	40	89 (28)	30	33 (20)	20
<b>WIC participation</b>								
Yes	116 (31)	21	347 (53)	44	199 (64)	51	105 (63)	62
No	255 (68)	78	304 (46)	55	110 (35)	48	61 (36)	37
Unknown	3 (1)	1	8 (1)	1	3 (1)	1	2 (1)	1
<b>Prenatal care payer</b>								
Insurance/HMO	77 (20)	79	236 (36)	60	148 (47)	46	78 (46)	52
Medicaid	260 (70)	14	337 (51)	28	118 (38)	40	64 (38)	35
Self-pay	7 (2)	1	9 (1)	2	4 (1)	1	1 (1)	1
Military	12 (3)	3	26 (4)	3	8 (3)	4	6 (4)	3
Other	15 (4)	3	32 (5)	5	22 (7)	7	13 (8)	6
Unknown	3 (1)	0	19 (3)	2	12 (4)	2	6 (3)	3
<b>Trimester prenatal care initiated</b>								
First	308 (82)	83	461 (70)	71	220 (71)	75	118 (70)	79
Second or third	40 (11)	11	131 (20)	20	54 (17)	13	38 (23)	16
No care	0 (0)	0	3 (0)	0	2 (1)	1	3 (2)	1
Unknown	26 (7)	6	64 (10)	9	36 (11)	11	9 (5)	4

Continued

TABLE 1—Continued

Prenatal care site								
Private physician's office/HMO clinic	243 (65)	76	338 (51)	63	134 (43)	56	80 (47)	60
Hospital clinic	69 (19)	12	136 (21)	15	83 (27)	19	40 (24)	15
Health department clinic	20 (5)	3	61 (9)	5	36 (12)	8	20 (12)	10
Community or migrant health center	10 (3)	1	23 (4)	3	14 (4)	3	5 (3)	3
Other	28 (7)	8	82 (12)	12	33 (10)	12	18 (11)	9
Unknown	4 (1)	0	19 (3)	2	12 (4)	2	5 (3)	3
Counseled on oral health care								
Yes	294 (79)	79	112 (17)	15	245 (79)	80	27 (16)	14
No	79 (21)	20	545 (83)	85	63 (20)	19	140 (83)	86
Unknown	1 (0)	1	2 (0)	0	4 (1)	1	1 (1)	0
Parity								
1	182 (49)	45	270 (41)	41	117 (38)	34	59 (35)	33
≥2	192 (51)	55	389 (59)	59	195 (62)	66	109 (65)	67
Body mass index, kg/m <sup>2</sup>								
<18.5 (underweight)	21 (6)	4	42 (6)	5	20 (6)	6	13 (8)	6
18.5–24.9 (normal)	245 (65)	66	310 (47)	48	153 (49)	54	80 (48)	47
25.0–29.9 (overweight)	57 (15)	16	153 (23)	25	70 (23)	20	33 (19)	21
≥30.0 (obese)	51 (14)	14	154 (24)	22	69 (22)	20	42 (25)	26
Smoked before pregnancy								
Yes	46 (12)	13	124 (19)	22	63 (20)	22	55 (33)	38
No	324 (87)	87	520 (79)	75	239 (77)	72	109 (65)	60
Unknown	4 (1)	0	15 (2)	3	10 (3)	6	4 (2)	2
Smoked during last 3 months of pregnancy								
No	356 (95)	96	593 (90)	85	278 (89)	89	133 (79)	78
Yes	16 (4)	4	61 (9)	14	31 (10)	10	34 (20)	22
Unknown	2 (1)	0	5 (1)	1	3 (1)	1	1 (1)	0
Ever smoked								
Yes	17 (5)	4	63 (10)	14	33 (11)	10	34 (20)	22
No	356 (95)	96	593 (90)	86	278 (89)	89	133 (79)	78
Unknown	1 (0)	0	3 (0)	0	1 (0)	1	1 (1)	0
Birthweight, g								
<2500	20 (6)	3	52 (8)	6	8 (3)	3	10 (6)	8
≥2500	349 (93)	96	604 (92)	93	304 (97)	97	158 (94)	92
Unknown	5 (1)	1	3 (0)	1	0 (0)	0	0 (0)	0
Estimated gestational age, wk								
<37	28 (7)	5	58 (9)	8	20 (7)	7	11 (6)	12
≥37	339 (91)	92	586 (89)	91	285 (91)	91	151 (90)	86
Unknown	7 (2)	3	15 (2)	1	7 (2)	2	6 (4)	2

Note. Of the 1592 respondents, 1513 (95%) had information available on dental care use during pregnancy. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.  
<sup>a</sup>Distribution of the characteristic among the survey respondents, weighted to account for sampling design, survey nonresponse, and sampling frame noncoverage.

sity<sup>17–19</sup> and smoking<sup>20–24</sup> have previously been shown to have an adverse effect on dental health care among nonpregnant populations; however, to our knowledge this is the

first study to report on these associations during pregnancy, providing new information on a serious and underaddressed problem among pregnant women.<sup>2,3</sup> Finally, the size of the in-

crease in risk associated with not receiving dental care and not being counseled on oral health care was similar regardless of whether or not women reported dental problems.

**TABLE 2—Risk of Nonreceipt of Dental Care During Pregnancy Associated With Selected Characteristics, by Presence or Absence of Self-Reported Dental Problems: Washington State PRAMS Study, 2000**

Characteristic <sup>a</sup>	No Reported Dental Problems		Reported Dental Problems	
	OR	95% CI	OR	95% CI
Income (monthly), \$ <sup>b</sup>				
<1200	1.27	0.58, 2.76	1.74	0.66, 4.59
1200–2099	1.62	0.78, 3.37	0.61	0.24, 1.59
2100–2999	1.00		1.00	
≥3000	0.65	0.35, 1.20	0.48	0.18, 1.24
WIC participation <sup>c</sup>				
Yes	1.75	1.04, 2.94	1.34	0.62, 2.90
No	1.00		1.00	
Prenatal care payer <sup>c</sup>				
Medicaid	1.05	0.56, 1.94	0.53	0.24, 1.15
Insurance/HMO	1.00		1.00	
Self-pay	1.73	0.38, 7.89	0.63	0.08, 4.97
Military	1.15	0.38, 3.48	0.52	0.11, 2.55
Other	1.19	0.43, 3.29	0.64	0.20, 2.08
Trimester prenatal care initiated <sup>d</sup>				
First	1.00		1.00	
Second or third	1.59	0.89, 2.85	1.00	0.47, 2.12
No care	...		0.62	0.05, 7.19
Prenatal care site <sup>e</sup>				
Private physician's office/HMO clinic	1.00		1.00	
Hospital clinic	0.84	0.46, 1.56	0.65	0.29, 1.47
Health department clinic	0.58	0.24, 1.38	1.00	0.33, 3.05
Community or migrant health center	0.66	0.17, 2.51	1.01	0.24, 4.36
Other	1.10	0.53, 2.30	0.68	0.24, 1.92
Counseled on oral health care				
Yes	1.00		1.00	
No	22.32	14.22, 35.02	26.42	12.46, 56.02
Body mass index, kg/m <sup>2c</sup>				
<18.5 (underweight)	1.90	0.82, 4.41	1.12	0.33, 3.81
18.5–24.9 (normal)	1.00		1.00	
25.0–29.9 (overweight)	1.89	1.14, 3.13	1.18	0.54, 2.59
≥30.0 (obese)	1.88	1.09, 3.25	1.52	0.73, 3.14
Smoked before pregnancy <sup>f</sup>				
Yes	1.74	0.98, 3.08	1.86	0.87, 3.94
No	1.00		1.00	
Smoked during last 3 months of pregnancy <sup>g</sup>				
Yes	3.52	1.53, 8.08	1.83	0.79, 4.22
No	1.00		1.00	
Ever smoked <sup>g</sup>				
Yes	3.57	1.57, 8.12	1.80	0.79, 4.12
No	1.00		1.00	

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; OR = odds ratio; CI = confidence interval.

<sup>a</sup>Reference group: women who received dental care during pregnancy.

<sup>b</sup>Adjusted for mother's race and education.

<sup>c</sup>Adjusted for mother's education and monthly income.

<sup>d</sup>Adjusted for mother's monthly income.

<sup>e</sup>Adjusted for mother's race, education, and monthly income.

<sup>f</sup>Adjusted for mother's marital status, race, and age.

<sup>g</sup>Adjusted for mother's race and monthly income.

When we conducted separate analyses according to receipt and nonreceipt of dental care during pregnancy, we found somewhat divergent risk factor patterns associated with self-reported dental problems. Among women who received dental care, the association with dental problems was significant for those with lower monthly incomes, those with Medicaid coverage, and those who reported ever having smoked. These results are generally consistent with the results of 2 cross-sectional studies suggesting that, among pregnant women, there is a relationship between low socioeconomic status and likelihood of not obtaining dental care.<sup>2,3</sup>

In contrast, we found no significant association between late prenatal care and dental care use. A previous PRAMS study conducted in Illinois, Louisiana, and New Mexico reported a 42% to 53% increased risk of nonuse associated with late prenatal care, but self-reported dental care problems were not examined.<sup>2</sup> In addition, this multistate PRAMS study did not control for confounders, which may have increased any risks associated with prenatal care; in this study, we controlled for multiple factors. Use of statewide PRAMS data to investigate the associations between risk factors and dental care allowed us to measure and take into account the influence of important confounding factors that have the potential to distort the associations between selected risk factors and dental care use, thus avoiding the probable overestimation or underestimation of reported associated risks.

Our study involved important methodological limitations. For example, our survey asked "Did you need to see a dentist for a problem?" but did not distinguish the type of dental problem or whether the woman underwent preventive care, a routine dental examination, restorative procedures, or emergency care. Data on type of care are important, because women who receive preventive care are less likely to develop periodontal disease, which has been linked to adverse birth outcomes such as preterm delivery.<sup>4,7,9,10,25,26</sup>

Similarly, PRAMS does not collect information on dental insurance coverage, which is a primary determinant in whether people obtain dental care.<sup>27–31</sup> Therefore, we were unable to assess the impact of dental coverage. Also, because we lacked important information on women's reasons for not obtaining dental care

**TABLE 3—Risk of Dental Problems Associated With Selected Characteristics, by Receipt or Nonreceipt of Dental Care During Pregnancy: Washington State PRAMS Study, 2000**

Characteristic <sup>a</sup>	Received Dental Care		Did Not Receive Dental Care	
	OR	95% CI	OR	95% CI
Income (monthly), \$ <sup>b</sup>				
< 1200	1.11	0.46, 2.67	1.44	0.61, 3.38
1200-2099	2.32	1.01, 5.34	0.77	0.32, 1.86
2100-2999	1.00		1.00	
≥ 3000	0.55	0.26, 1.15	0.37	0.16, 0.87
WIC participation <sup>c</sup>				
Yes	1.62	0.83, 3.18	1.37	0.68, 2.77
No	1.00		1.00	
Prenatal care payer <sup>c</sup>				
Medicaid	2.24	1.14, 4.38	0.87	0.39, 1.94
Insurance/HMO	1.00		1.00	
Self-pay	0.57	0.10, 3.17	0.32	0.04, 2.58
Military	1.40	0.41, 4.78	0.99	0.24, 4.08
Other	2.50	0.80, 7.83	1.07	0.35, 3.28
Trimester prenatal care initiated <sup>d</sup>				
First	1.00		1.00	
Second or third	0.71	0.35, 1.44	0.60	0.32, 1.13
No care	...		2.76	0.33, 22.97
Prenatal care site <sup>e</sup>				
Private physician's office/HMO clinic	1.00		1.00	
Hospital clinic	0.98	0.42, 2.87	1.62	0.56, 4.66
Health department clinic	1.09	0.42, 2.87	1.62	0.56, 4.66
Community or migrant health center	0.81	0.17, 3.96	1.39	0.32, 5.94
Other	0.81	0.31, 2.11	0.73	0.29, 1.80
Counseled on oral health care				
Yes	1.00		1.00	
No	0.95	0.56, 1.60	1.12	0.55, 2.26
Body mass index, kg/m <sup>2c</sup>				
< 18.5 (underweight)	2.33	0.87, 6.22	1.20	0.39, 3.68
18.5-24.9 (normal)	1.00		1.00	
25.0-29.9 (overweight)	1.65	0.89, 3.05	0.92	0.45, 1.85
≥ 30.0 (obese)	1.31	0.66, 2.60	1.17	0.61, 2.25
Smoked before pregnancy <sup>f</sup>				
Yes	1.72	0.86, 3.44	1.69	0.88, 3.26
No	1.00		1.00	
Smoked during last 3 months of pregnancy <sup>g</sup>				
Yes	2.63	0.90, 7.69	1.15	0.54, 2.45
No	1.00		1.00	
Ever smoked <sup>g</sup>				
Yes	2.63	1.13, 6.19	1.10	0.52, 2.34
No	1.00		1.00	

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; OR = odds ratio; CI = confidence interval.

<sup>a</sup>Reference group: women who reported no dental problems during pregnancy.

<sup>b</sup>Adjusted for mother's race and education.

<sup>c</sup>Adjusted for mother's education and monthly income.

<sup>d</sup>Adjusted for mother's monthly income.

<sup>e</sup>Adjusted for mother's race, education, and monthly income.

<sup>f</sup>Adjusted for mother's marital status, race, and age.

<sup>g</sup>Adjusted for mother's race and monthly income.

(e.g., perceived fear of harm to their fetus), our ability to examine behavioral determinants was limited. Finally, nonrespondents were more likely to be multiparous, unmarried, and Black and less likely to have completed high school than respondents, raising the possibility of non-response bias. However, because nonrespondents were similar, in terms of demographic characteristics, to respondents who did not have optimal dental care, we believe that such a bias would underestimate the reported risks.

Despite these limitations, our findings should illustrate to health care providers and public health clinics that pregnant women frequently do not obtain dental care and have unmet dental care needs. Our findings also suggest several important clinical and public health interventions. Since 83.4% of all women begin prenatal care in their first trimester, our results may encourage the development of strategies for early identification of risk factors among women who have dental care problems or do not receive dental care.<sup>32</sup>

Providers and public health clinics already have an established role in the prevention and early identification of health problems and routinely discuss a variety of topics; this role could be expanded to include provision of counseling and screening on oral health and dental care in early pregnancy. Surprisingly, 54% of the women taking part in our study reported that they had not been counseled on how to care for their teeth and gums, and the overall frequency of pregnant women not receiving dental care during pregnancy was relatively high. Since dental diseases are preventable, maternity care providers have a unique opportunity during routine prenatal visits to provide simple, preventive counseling on oral health. At a minimum, providers should advise women about proper care (e.g., flossing and brushing).<sup>33</sup> Our results indicate a need for repeated screening of women at greater risk of unmet oral care needs, particularly women who are obese or smoke.

Because, to our knowledge, no US general population-based surveys oversample pregnant women or provide sufficient dental care information on a representative sample of such women,<sup>34</sup> and because the PRAMS state-based population-based surveillance system is the closest we have to a national surveillance system, refinement of the dental

care questions merits further consideration. Redesigned comprehensive questions with established psychometric properties regarding preventive and reparative care and dental insurance coverage would provide more useful information amenable to intervention and program planning. Also, explorations of linkages between PRAMS and dental claims data may allow not only evaluation of temporal issues surrounding dental care use but also determination of whether antenatal dental care events are related to subsequent outcomes such as preterm delivery or low birthweight.

In conclusion, given the markedly low rate of dental care counseling reported by the present sample of pregnant women, there is a need for enhanced education and training of physicians, midwives, and other practitioners concerning oral health in pregnancy. Since women who do not receive dental care during their pregnancy are more likely to be obese or to smoke, lack of dental care may be a marker for poor health. Paralleling other perinatal health trends, oral health risk factors highlight the importance of known effective preventive prenatal care interventions such as smoking cessation. Finally, because obesity and tobacco use may spuriously indicate non-causal associations between dental problems such as periodontitis and adverse pregnancy outcomes, these factors should be taken into account in future research.<sup>35</sup> ■

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### Contributors

M. T. Lydon-Rochelle conceived the study and supervised all aspects of its completion. P. Krakowiak and R. M. Peters assisted with the programming and analyses. P. P. Hujoiel assisted with data interpretation. All of

the authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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The Human Subjects Protection Review Board of the State of Washington Department of Health approved this study for minimal risk status.

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# Effects of WIC Participation on Children's Use of Oral Health Services

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Dental disease and access to dental care are major public health problems for young low-income children living in the United States. This national dilemma has recently come under close scrutiny by policymakers, health care providers, and researchers.<sup>1,2</sup> Because of frequent interactions with low-income children and their families, several public health programs can help alleviate dental problems and improve access to dental care. An example of such a program is the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). WIC is administered by the Food and Nutrition Services of the US Department of Agriculture and serves more than 7.4 million individuals.<sup>3</sup> Over one third of infants born in the United States are enrolled in the WIC program. It is often the first contact with the health care system for many poor women and children. The primary goal of WIC is to "improve the health of women and children by providing nutritious foods, nutrition education and good health care during pregnancy, the postpartum period, infancy and early childhood."<sup>4(p391)</sup> To achieve its goal, WIC agencies work to improve the linkage between clients and health care providers, including dentists, through referrals and networking.<sup>5</sup>

## WIC and Medical Care

Several investigations have demonstrated the effectiveness of WIC in providing positive health outcomes. Among the benefits are a reduced frequency of low-birthweight deliveries,<sup>6-8</sup> reduced Medicaid costs for newborns,<sup>9</sup> reduced rates of anemia in children,<sup>6</sup> and increased nutrient intake in children.<sup>10</sup> The health effects of WIC participation are attributed to the direct nutrition-related benefits of the program rather than to the benefits of coordination of health and social services.<sup>11</sup> However, the beneficial effects of the coordination of health services cannot be dismissed

**Objectives.** We estimated the effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) on dental services use by Medicaid children in North Carolina.

**Methods.** We used linked Medicaid claims and enrollment files, WIC files, and the area resource file to compare dental services use for children enrolled in WIC with those not enrolled. We used multivariate models that controlled for child clustering and employed 2-step methodology to control for selection bias.

**Results.** Children who participated in WIC had an increased probability of having a dental visit, were more likely to use preventive and restorative services, and were less likely to use emergency services.

**Conclusions.** Children's WIC participation improved access to dental care services that should lead to improved oral health. (*Am J Public Health.* 2004;94:772-777)

readily.<sup>12</sup> Referral of children to health and social services is an important component of WIC programs. WIC counselors advise families about the location of clinics and programs, such as Medicaid and the State Children's Health Insurance Program, that help pay for health care.

Few studies have addressed the effects of WIC on the utilization of health care services.<sup>3,6,10</sup> One investigation demonstrated that WIC participants used a children's clinic more frequently than did nonparticipants.<sup>12</sup> In a recently published study, Buescher et al. reported that "Medicaid-enrolled children participating in the WIC program use all types of health care services compared with Medicaid-enrolled children who were not WIC participants."<sup>13(p145)</sup> They concluded that "the health care needs of low-income children who participate in WIC may be better met than those of low-income children who were not WIC participants."<sup>13(p145)</sup>

## WIC and Oral Health Care

Only 2 small, descriptive studies have investigated the relation between participation in WIC programs and referrals for oral health care. McCuniff et al.<sup>14</sup> examined dental referral rates by WIC clinics in Missouri, reporting that of the 1850 participants seen during

a 2-month period at a clinic site, 27% of children and 17% of infants were referred for services outside the WIC clinic. Using self-reported information from caregivers, McCuniff et al.<sup>14</sup> also reported a statistically significant bivariate relation between WIC referral and having a dental visit. Dental referrals constituted 10% of these referrals made for infants and children. Sargent et al.<sup>15</sup> used a survey of WIC employees in an inner-city clinic to examine referral patterns. WIC nutritionists at this site offered a variety of referrals to their clients. One fifth of WIC participants were referred to health services, and referrals for dental care constituted the majority of these referrals. Results of these 2 studies suggest that dental referrals do take place within WIC clinics, but the proportion of all referrals due to a dental problem varied considerably. Furthermore, the outcome of these referrals is largely unknown.

Findings from previous WIC and health care utilization investigations are further limited because they do not control for the non-randomized nature of WIC participation.<sup>13,16</sup> We build on these past studies in an investigation of WIC participation and use of dental services by using claims data rather than self-reports and by employing multistage modeling to control for selection bias. Using these

more sophisticated analytic techniques in our exploration of the effects of WIC on use of oral health services, we provide an estimate of the effectiveness of WIC programs in linking clients with dental providers. Specifically, we determined whether, compared with Medicaid children who did not participate in WIC, preschool-aged Medicaid children enrolled in WIC had an increased likelihood of having had a dental visit and whether it was of a certain type (preventive, restorative, or emergency).

## METHODS

We tested the hypothesis that children enrolled in WIC have better access to dental care than children not enrolled in WIC. For purposes of this investigation, we defined *access* as use of services that was represented by Medicaid claims data. We measured the effects of children's WIC participation on the probability of a child's having had a dental visit and the different types of visits. Available sociodemographic variables were included as control variables in our analyses.

### Data Sources and Study Cohort

We used the following linked North Carolina administrative data sets for our investigation: composite birth records, Medicaid eligibility enrollment files, Medicaid dental claims, WIC files, and the area resource file. The linkage process for these files has previously been reported, and a matching rate of 98.5% was established.<sup>13</sup>

All children born in North Carolina in calendar year 1992 who were enrolled in the Medicaid program were eligible for inclusion in the study. Children were excluded if they had more than 1 Medicaid identification in their records (759 children) or if they had recorded periods of Medicaid enrollment indicated before the date of birth (1371 children). A Medicaid enrollment history was created for each child in which enrollment status was indicated for each month of life from birth to the age of 5 years (months 1 through 60).

### Analysis Strategy

Using various multiple regression analyses with control variables, we determined the re-

lation of children's WIC participation and the use of oral health services. Several analytic challenges had to be considered. Because our investigation followed children for 5 years, the data set contained multiple observations per child that can result in correlated error terms and bias results. To control for this problem, we used robust standard errors and controls for clustering around the child in the regression analysis. Panel data techniques using random effects models were used in each analysis.

Another important analysis consideration was the potential for selection bias. Because WIC participation was not randomly determined among Medicaid children, we anticipated that children who participated in WIC would more likely be users of health care services than other Medicaid children. This assumption suggests the potential for correlation between the WIC participation variable and the error term of our main analysis. Failure to account for this correlation could bias our results. To control for this potential bias, we incorporated a 2-stage multilevel model using instrumental variables as outlined by Bollen et al.<sup>17</sup> We screened potential instrumental variables for their close association with WIC participation. Three instrumental variables (number of WIC clinics per county, number of full-time WIC workers per county, and WIC hours of operation per county) were correlated with WIC participation but not with dental utilization and were used in our analysis.

The primary measure of oral health utilization was a 3-level variable defined as no visits, 1 visit, or 2 or more visits per year as represented by dental claims. These categories were used because the recommended number of dental visits is 2 per year.<sup>18</sup> We did not distinguish among the number of visits greater than 2 per year because those differences are likely to depend on the severity of dental disease rather than basic issues associated with access to care. Because the measure of this dependent variable was coded as 0, 1, and 2, we used an ordered probit analysis with controls for clustering to examine WIC and oral health services utilization for each observation year (1 through 4).

We used separate random effects logit analyses (logistic regression) for each type of

oral health services used. *Type of services received* was classified as (1) diagnostic/preventive services, (2) restorative services, and (3) emergency services. The American Dental Association procedure codes were used to classify service categories.<sup>18</sup> Additionally, if a child had a hospital emergency room claim with a primary diagnosis of dental caries<sup>19</sup> it was included as an emergency visit. These visit types were coded 0 or 1 to represent each type of visit per year as indicated by Medicaid claims.

Our major explanatory variable was children's WIC participation measured as the number of months when any WIC voucher was redeemed during each year of life. We also incorporated relevant available sociodemographic control variables into our analysis. These included maternal educational level (years of school completed), maternal age (years), household income (actual dollar amounts), marital status (unmarried vs married), and minority status (non-White vs White). Many of these variables have been reported as important determinants of access to oral health care.<sup>20–22</sup> In addition, we used length of Medicaid enrollment (months) and dentists-to-population ratio in our analyses.

## RESULTS

### Descriptive Statistics

Summary statistics for the study cohort are presented in Table 1. Of the 81 518 live births in North Carolina in 1992, 53 591 children were enrolled in Medicaid and 49 795 met the study inclusion criteria at birth. Our cohort was reduced to 21 277 at 1 year of age because the eligibility for Medicaid changes from 185% of the federal poverty level during the first year of life to 133% of the federal poverty level thereafter. Approximately 18% of the children born with Medicaid benefits remained continuously enrolled. Approximately 12% stayed continuously enrolled in WIC for the entire 5-year study period. The average number of months per year enrolled in Medicaid was 7.6. More than 50% of the cohort was on WIC at any time during the study period. The average length of children's WIC participation was 4.4 months per year. The average maternal age was 21 years, with an average educational level of 11th grade.

**TABLE 1—Characteristics of the Study Population: North Carolina, 1992–1997**

	Mean or Percentage	SD	Minimum	Maximum
<b>WIC variables</b>				
Time WIC vouchers were used, mo per year	4.47	3.06	0	12
Infant WIC participation	51%	0.33	0	1
<b>Outcome variables</b>				
Any dental visit in a year	7.1%	0.25	0	1
Number of dental visits per year	0.4	2.02	0	6
Had a preventive visit in a year	6.6%	0.25	0	1
Had a restorative visit in a year	2.2%	0.15	0	1
Had an emergency visit in a year	1.5%	0.12	0	1
<b>Control variables</b>				
Maternal age, y	21	5.51	13	39
Maternal education	11th grade	4.39	9	18
Medicaid enrollment, mo per year	7.6	5.26	1	12
Household income, \$	20 550	4140	12200	29130
No. dentists/population	6.820	3.81	0	17.6
Unmarried	54%	0.48	0	1
Non-White	48%	0.50	0	1

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Forty-eight percent of the population was non-White. In each observation year, 7% of the sample had a dental visit of any type, 6% had a preventive visit, 2% had a restorative visit, and 1% had an emergency visit. Overall, 12.1% of the cohort used oral health services before the age of 5 years.

**Analytic Results**

The analytic file consisted of 4 observations per child (n=49 795) representing 1 for each year of life until the age of 5 years, for a total of 199 180 child-year observations. Because the first year of life represented the infant year and use of oral health services was extremely low, we omitted this year from our analysis, leaving 4 observation years for ages 1 through 4 years. Table 2 illustrates the model results of our analysis of children’s WIC participation and oral health services utilization (any visit, 1 visit, 2 or more visits per year). Children’s WIC participation was a significant ( $P<.01$ ) factor with a positive effect on oral health services utilization. Also significant in the model were Medicaid enrollment ( $P<.01$ ), household income ( $P<.05$ ), dentist-to-population ratio ( $P<.05$ ), and being non-White ( $P<.05$ ).

Table 3 illustrates the likelihood of dental visits by level of WIC participation. These re-

**TABLE 2—Ordered Probit Model Results for WIC and Use of Oral Health Services: North Carolina, 1992–1997**

Variables	Estimated Coefficient (SE)
<b>WIC variables</b>	
Child WIC participation	0.043*** (0.013)
Infant WIC participation	0.032*** (0.011)
<b>Control variables</b>	
Maternal age	0.014* (0.00086)
Maternal education	-0.0017 (0.0016)
Medicaid enrollment	0.101*** (0.006)
Household income	0.060** (0.014)
Dentists/population	0.015** (0.007)
Unmarried	-0.0013* (0.00078)
Non-White	-0.32** (0.014)
Constant 1	2.52 (0.030)
Constant 2	2.89 (0.030)

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.  
\* $P<.10$ ; \*\* $P<.05$ ; \*\*\* $P<.01$ .

sults were calculated using the base-case child (White, maternal age of 21 years, maternal educational level of grade 11, household income of \$20 550, and mother married and enrolled in Medicaid for 7.6 months). Children who participated in WIC

for a full year were about 1.7 times more likely to have 2 or more dental visits per year than those children who never participated in WIC (odds ratio [OR]=1.67; 95% confidence interval [CI]=1.45, 1.78). Children who participated in WIC for a full year were about 1.5 times more likely to have 1 dental visit than children not on WIC (OR=1.46; 95% CI=1.32, 1.56).

Table 4 presents results for the 3 logit models for children’s WIC participation and type of dental visit. Children’s WIC participation was significant ( $P<.01$ ) and had a positive effect on the likelihood of a preventive or restorative visit and a negative and marginally significant effect ( $P<.10$ ) on emergency visits. Table 3 presents the likelihood of type of dental visit by level of WIC participation. Children who participated in WIC for 12 months were more likely to have a preventive visit (OR=1.98; 95% CI=1.85, 2.02) and a restorative visit (OR=1.69; 95% CI=1.56, 1.87) but less likely to have an emergency visit (OR=0.68; 95% CI=0.56, 0.89) than children who did not receive WIC services.

**DISCUSSION**

This investigation represents the first detailed examination of children’s WIC participation and oral health care utilization. Previous studies have substantiated that WIC participation has an effect on the use of prenatal care and children’s medical care.<sup>3,6,10</sup> Our findings indicate that children who participate in WIC are more likely to have a dental visit, thus increasing their access to oral health care. Because children on Medicaid are a high-risk population who often need more frequent and extensive dental services than other children, the association between WIC and greater use of services suggests that children on both Medicaid and WIC are more likely to receive the care they need.

Our results also showed that young children participating in the WIC program are more likely to use preventive and restorative services and are less likely to use emergency services than WIC nonparticipants. These findings suggest that children participating in WIC may have a better connection to the health care system that can lead to care that is more planned and less urgent. If further

**TABLE 3—Odds Ratios for Dental Services Use, by Level of WIC Participation: North Carolina, 1992–1997**

	No WIC Participation (Reference Group)	6-Month WIC Participation	1-Year WIC Participation
≥ 2 Dental visits per year	1.0	1.51***	1.67***
1 Dental visit per year	1.0	1.26**	1.46***
No dental visits	1.0	0.85*	0.79**
Preventive care visit	1.0	1.59***	1.98***
Restorative care visit	1.0	1.26***	1.69***
Emergency care visit	1.0	0.79*	0.68*

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; OR = odds ratio.  
\* $P < .10$ ; \*\* $P < .05$ ; \*\*\* $P < .01$ .

**TABLE 4—Random Effects Logit Models for WIC and Type of Visit: North Carolina, 1992–1997**

	Preventive Visit (SE)	Restorative Visit (SE)	Emergency Visit (SE)
WIC variables			
Child WIC participation	0.065 (0.026)***	0.047 (0.0035)***	-0.036 (0.0021)*
Control variables			
Maternal age	0.0048 (0.0011)***	0.037 (0.0014)***	0.00070 (0.0015)
Maternal education	-0.0050 (0.0015)***	-0.0097 (0.0026)***	-0.011 (0.0028)***
Medicaid enrollment	0.140 (0.0018)***	0.12 (0.0028)***	0.11 (0.0029)***
Household income	-0.0030 (0.0015)**	-0.020 (0.0085)**	-0.015 (0.0045)***
No. dentists/population	0.023 (0.0096)**	0.016 (0.0021)**	-0.020 (0.0024)***
Unmarried	-0.0041 (0.0025)*	-0.002 (0.018)	-0.033 (0.019)*
Non-White	-0.038 (0.030)***	-0.014 (0.0072)**	-0.047 (0.018)***
Constant	-2.70 (0.58)***	-3.13 (0.77)***	-3.05 (0.87)***

Note. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.  
\* $P < .10$ ; \*\* $P < .05$ ; \*\*\* $P < .01$ .

studies can confirm a causal link between activities of a WIC nutritionist, dental referral, and use of dental services, it would appear that an important facet of the mission of WIC programs—appropriate referrals to health and social services—is being addressed. Our study contributes to the literature in 2 major ways: by broadening the understanding of the effects of WIC participation to oral health care and by making a methodological improvement on the way WIC effects are examined.

### Methodological Contributions

Our study is the first to examine the WIC program and health services utilization with the 2-step statistical modeling approach. A strong criticism of previous WIC children's

health studies is their inability to control for the potential selection bias of enrollment in the WIC program.<sup>16</sup> We conducted extensive tests for these sources of bias in the relation between WIC enrollment and use of oral health services and found that selection bias did exist. Random assignment of families to WIC participation would be a stronger design and would help overcome any selection bias. However, the practical problem of implementing this strategy in a community-based setting would be daunting, and such a design is not ethically defensible. To help control for selection bias, we used the 2-step methodology as described by Bollen et al.<sup>17</sup> This approach makes a significant contribution to the literature about the WIC program because the majority of studies that examine the WIC pro-

gram have been unsuccessful in recognizing and correcting for selection bias (endogeneity).<sup>16</sup> Our study also demonstrates the feasibility of using 2-step analysis to control for selection bias when examining the effects of WIC on oral health care use.

Sporadic and continuously enrolled Medicaid children differ demographically, socially, and economically,<sup>23</sup> so we did not limit the cohort to continuously enrolled children. Doing so would have biased the sample and threatened generalizability. Continuously enrolled children in our cohort had utilization rates for oral health services that were 3 times greater than those not enrolled continuously in Medicaid (30% vs 10%).<sup>24</sup> Instead, we controlled for Medicaid enrollment with a variable for duration of months per year enrolled in the program. However this approach can create another bias because low-income children qualifying for Medicaid may receive dental care under private insurance, with fee for service, or at no cost during periods in which they are not enrolled in Medicaid. Although low-income children are likely to use medical care when not enrolled in public insurance programs, it is unlikely that they receive dental care, particularly young children in North Carolina, where excess demand for services exists and dentists' participation in Medicaid is low.<sup>25</sup> Furthermore, dental care is the most prevalent unmet need in uninsured children who are eligible for Medicaid.<sup>26</sup> These findings underscore the difficulty young low-income children have in gaining access to oral health care regardless of insurance coverage.

### Policy Contributions

In the policy area, we have several noteworthy findings. Our results indicate that children's WIC participation has a significant and positive effect on oral health services utilization during the first 5 years of life. This finding is important because inadequate access to dental care is commonplace among children of families living in poverty. This situation has been documented in numerous national and state reports including those from the Office of the Inspector General,<sup>27</sup> the American Dental Association,<sup>19</sup> the General Accounting Office,<sup>28</sup> the surgeon general,<sup>2</sup> and the North Carolina Institute of Medicine.<sup>29</sup>

In the North Carolina Institute of Medicine report on access to dental care, it was reported that fewer than 13% of children aged 1 to 5 years received any dental services. Our findings indicated that WIC participation could increase to 23% the use of dental services for children at this age. This is an increase of almost 50% compared with findings of the North Carolina Institute of Medicine. Even with this rather dramatic percentage increase in use, the absolute utilization of 23% is still relatively low; more work needs to be done to address the access to dental care crisis among low-income young children. Medicaid alone is not enough to provide sufficient access to oral health care for young children, but when available in combination with another public health program such as WIC, access to oral care health can be greatly improved.

### Limitations

These results should be considered in light of the study's limitations. First, we have a short study duration of 4 years (ages 1 through 4). For this reason, we chose the random effects model and not the fixed effects as suggested by Judge.<sup>30</sup> The random effects model was able to control time-invariant variables as well as time-variant ones. We analyzed the child-level claims records and used panel data techniques that have not been applied in previous studies of WIC participation and use of services. Although we feel that we have made methodological improvements in the evaluation of WIC participation, future work should draw on additional years of panel data and address future questions such as the long-term oral health effects of the WIC program. In addition, because we examined the WIC program in only 1 state, this study needs to be replicated in other states. A single, expanded study with several states would involve considerable time and costs but could provide more generalizable and precise effects of the WIC program on access to oral health services.

We do not have information on children's oral health status in the study. It is well documented that Medicaid children and children living in poverty have disproportionately more dental disease.<sup>31</sup> Thus, any dental visit is likely to be beneficial to this high-risk popu-

lation. The association of WIC with higher use of services may mean that oral health care needs of the children on Medicaid who participate in WIC are being better met. The findings for number of visits and type of use support this conclusion. Also, the adjusted odds of a child on Medicaid with WIC participation having 1 or more dental claims during the year was 1.3 to 1.5 times greater than that of a child with no WIC participation, across the 4 age groups. Studies have suggested that dental care is a serious unmet need among children in poverty, and our study suggests that use of dental care is enhanced among children participating in WIC services. ■

### About the Authors

At the time of this investigation, Jessica Y. Lee was a PhD candidate in health policy and administration at the University of North Carolina, Chapel Hill, School of Public Health. R. Gary Rozier and Edward C. Norton are with the Department Health Policy Analysis and Administration, University of North Carolina, Chapel Hill. William F. Vann Jr is with the Department of Pediatric Dentistry, University of North Carolina, Chapel Hill. Jonathan B. Kotch is with the Department of Maternal and Child Health, University of North Carolina, Chapel Hill.

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### Contributors

All authors participated in the conception, design, data analysis, and interpretation of the study. J.Y. Lee and R.G. Rozier wrote the first drafts of the article, and E.C. Norton, J.B. Kotch, and W.F. Vann contributed to subsequent versions.

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### Human Participant Protection

No human subjects participated in this study. The protocol for this investigation was approved by the institutional review board at the University of North Carolina, Chapel Hill, School of Public Health.

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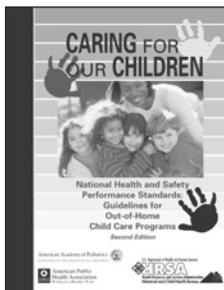
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# Does Supplemental Private Insurance Affect Care of Medicare Recipients Hospitalized for Myocardial Infarction?

Jing Fang, MD, and Michael H. Alderman, MD

Coronary heart disease remains the leading cause of death and disability in the United States, despite a sustained decline in age-adjusted mortality over the past 4 decades.<sup>1,2</sup> Improved hospital survival after acute myocardial infarction may have been the largest contributor to this decline. Many factors affect individuals' short-term prognosis after a myocardial infarction. For example, health insurance status, while often signifying the presence or nonpresence of financial resources to purchase specific care, might be a marker of general socioeconomic status. Patients with different types of health insurance coverage but similar medical problems have been shown to receive treatment that differs in form and intensity, which may affect short- as well as long-term outcomes.<sup>3</sup> More specifically, race, insurance status, and income have all been associated with unequal use of revascularization procedures among coronary heart disease patients.<sup>4-6</sup>

Measuring and monitoring access to health care is a central concern of public health and health service researchers, and it has been of great interest to the federal government since the establishment of Medicare and Medicaid benefits in 1966.<sup>7,8</sup> Because Medicare provides nearly universal hospital insurance coverage after the age of 65 years, we hypothesized that differences in revascularization prominently associated with insurance status among younger persons<sup>9</sup> might be ameliorated or disappear after age 65. Since some Medicare beneficiaries also have supplemental insurance coverage, we wondered whether this additional coverage influenced medical services or survival.

To address this issue, we examined data from the New York State Department of Health's Statewide Planning and Research Cooperative System (SPARCS). We found, as reported subsequently, that race and gender continue to influence revascularization use and in-hospital mortality among Medicare recipients hospitalized for acute

**Objectives.** We sought to determine whether supplemental private insurance coverage among Medicare recipients alters patterns of health care or outcomes associated with acute myocardial infarction.

**Methods.** Medicare patients hospitalized after a myocardial infarction were identified from New York City hospitalization records. Patients who had only Medicare coverage were compared with those who had supplemental private or public insurance coverage.

**Results.** Patients with supplemental private insurance exhibited increased rates of revascularization and decreased rates of in-hospital mortality relative to patients with either Medicare only or Medicare and public insurance. Moreover, Blacks and women were less likely to undergo revascularization and exhibited higher in-hospital mortality rates.

**Conclusions.** Despite Medicare, private insurance coverage appears to influence the likelihood of coronary revascularization among older patients hospitalized for acute myocardial infarction. (*Am J Public Health.* 2004;94:778-782)

myocardial infarction. However, supplemental private insurance coverage favorably affects both in-hospital care and hospital survival.

## METHODS

### Data

In this study, we used SPARCS data from the years 1988 through 2001.<sup>10</sup> SPARCS contains discharge data abstracted for at least 95% of all New York State acute care hospitalizations other than those involving psychiatric and federal hospitals. SPARCS data include patients' disposition, age, gender, race, admission status, physician and hospital identifiers, principal diagnosis and up to 14 secondary diagnoses, principal procedure code and up to 14 other procedure codes, principal payment resource, and second payment resource. Data records in the system are abstracted from medical records by trained medical records personnel in each hospital, and the New York State Department of Health is responsible for verifying the accuracy of reported information. The present analysis included all records of hospitals located in the 5 boroughs of New York City.

Diagnostic coding was based on the *International Classification of Diseases, 9th Revision*,

*Clinical Modification (ICD-9-CM)*.<sup>11</sup> Myocardial infarction was defined according to its appearance as the principal diagnosis code (ICD-9 codes 410.0-410.9). Other diagnostic codes identified comorbid conditions and complications. Patients' disposition signified their vital status at discharge.

In this study, the outcomes of interest were revascularization procedure use and in-hospital mortality. Revascularization was coded as percutaneous transluminal coronary angioplasty (PTCA) (ICD-9 codes 36.01, 36.02, and 36.05) or coronary artery bypass grafting (CABG) (ICD-9 codes 36.10-36.19). Discharge status was used in determining in-hospital mortality.

A priori risk factors selected for this study included general risk factors (e.g., age, gender, race, length of hospital stay, and admission status), comorbid conditions (e.g., diabetes [ICD-9 code 250], hypertension [ICD-9 codes 401-405]), and complications of myocardial infarction, including congestive heart failure (ICD-9 code 428). We established whether patients had experienced a previous myocardial infarction by reviewing their medical records for mention of such an event (ICD-9 code 412). The location of the myocardial infarction was categorized as anterior (ICD-9 codes 410.0-410.1), lateral/inferior

(ICD-9 codes 410.2–410.6), or subendocardial (ICD-9 code 410.7).

Insurance status was based on primary and secondary coverage. Patients were categorized in the following groups: (1) Medicare only; (2) Medicare with supplemental private insurance, including both Medicare and any comprehensive private insurance plan; and (3) Medicare with other public insurance, including both Medicare and Medicaid coverage.

Study patients were limited to those older than 65 years who reported having Medicare insurance coverage (88% of all patients 65 years or older reported having such coverage) and who were discharged from the hospital with a principal diagnosis of acute myocardial infarction. Because 93% of the patients were non-Hispanic Whites, non-Hispanic Blacks, or Hispanics, patients in other race/ethnicity groups were eliminated. Length of hospital stay categories were less than 3 days, 3 to 7 days, and more than 7 days. Admission status was categorized as emergency, urgent, or elective. Patients who were discharged from the hospital alive and who had been in the hospital fewer than 3 days were eliminated from our analyses because acute myocardial infarction was likely to have been ruled out among these patients.

### Statistical Analysis

Associations between insurance status and sociodemographic characteristics, revascularization use, and hospital outcome were established. Multiple logistic regression models were used to estimate odds ratios and 95% confidence intervals for factors related to revascularization, as well as in-hospital mortality, controlling for other characteristics that differed significantly in the univariate analysis. Logistic regression models also were used in examining subgroups established through stratification according to race/ethnicity.

## RESULTS

### Patient Characteristics

During the study period, 124 599 Medicare patients hospitalized as a result of myocardial infarction were available for analysis. More than half of these patients (51.3%) were women; 11.5% were non-Hispanic Blacks, and 9.4% were Hispanics. Overall, 42.3%

**TABLE 1—Sample Characteristics, by Insurance Group**

	Medicare Only (Group 1)	Medicare With Private Insurance (Group 2)	Medicare With Public Insurance (Group 3)	Group Comparisons (P)		
				1 vs 2	1 vs 3	2 vs 3
Age, y, mean (SD)	77.4 (7.7)	77.5 (7.5)	77.5 (8.1)	>.05		
Men, %	48.7	52.2	38.2	<.001		
Race/ethnicity, %						
Black	12.5	5.6	19.3	<.001		
Hispanic	10.5	2.4	21.3			
Emergency admission, %	87.3	80.1	83.8	<.001		
Hospital stay >7 d, %	59.6	51.8	52.9	<.001		
Hypertension, %	40.4	46.9	56.2	<.001		
Diabetes, %	26.7	26.0	38.8	.14	<.001	<.001
Congestive heart failure, %	42.6	42.5	46.1	.52	<.001	<.001
Previous MI, %	3.9	5.4	4.3	<.001		
Anterior MI, %	25.9	23.3	20.5	<.001		

Note. MI = myocardial infarction.

had Medicare as their only health insurance, 39.1% had supplemental private insurance, and 18.6% had both Medicare and Medicaid. Patients' average age was 76.9 years; 57.5% were older than 75 years. There were no differences in age among patients in the different insurance status categories.

In comparison with patients who had Medicare coverage only, patients with supplemental private insurance were more likely to be White and male and to have had a previous myocardial infarction. Those with Medicare and other public insurance coverage were more likely to be female, Black, or Hispanic and more likely to have hypertension, diabetes, and congestive heart failure. Blacks and Hispanics were more likely than Whites to have Medicare in combination with other public insurance coverage and to have only Medicare coverage. Other characteristics, including length of hospital stay and admission status, differed significantly among the 3 insurance groups as well (Table 1).

### Revascularization and Mortality

Among the study group as a whole, as well as in the case of Whites, those with supplemental private insurance coverage exhibited the highest rate of PTCA use, followed by those with supplemental public insurance; patients who had only Medicare coverage exhibited the lowest rate of PTCA use (Table 2).

Among Blacks and Hispanics, those with supplemental private insurance exhibited the highest frequency of PTCA, while there were no differences between those with Medicare coverage only and those with Medicare and supplemental public insurance coverage. This was also the case for overall rates of CABG use, as well as race/ethnicity- and gender-specific rates (Table 2). Altogether, revascularization was most frequent among Hispanics and least frequent among Blacks, and this was particularly true in the case of PTCA.

In-hospital mortality was highest among patients with only Medicare insurance coverage, followed by those with supplemental public insurance; those with supplemental private insurance exhibited the lowest in-hospital mortality. When stratified according to race/ethnicity and gender, in-hospital mortality was highest among Whites, lowest among Hispanics, and higher among women than among men (Table 3).

Associations between insurance status, gender, race/ethnicity, and revascularization procedures (PTCA and CABG), as well as in-hospital mortality, were explored through logistic regression analyses controlling for other characteristics such as age, comorbid conditions (diabetes, hypertension), length of hospital stay, presence of congestive heart failure, admission status, previous myocardial infarction, and location of myocardial infarction

**TABLE 2—Percentages of Patients Undergoing PTCA or CABG, by Race, Gender, and Insurance Status**

	Medicare Only (Group 1)	Medicare With Private Insurance (Group 2)	Medicare With Public Insurance (Group 3)	Group Comparisons (P)		
				1 vs 2	1 vs 3	2 vs 3
<b>PTCA</b>						
Overall	7.7	13.3	9.0	<.001		
White men	7.6	12.9	9.9	<.001		
Black men	4.6	10.2	4.7	<.001	.43	<.001
Hispanic men	8.8	15.4	8.9	<.001	.53	<.001
White women	5.2	10.2	5.9	<.001	.01	<.001
Black women	4.8	7.9	4.6	<.001	.29	<.001
Hispanic women	6.4	18.3	6.6	<.001	.61	<.001
<b>CABG</b>						
Overall	7.1	10.2	7.2	<.001	.37	<.001
White men	8.4	11.6	8.6	<.001	.12	<.001
Black men	4.4	7.4	4.3	<.001	.45	<.001
Hispanic men	6.0	11.6	6.3	<.001	.29	<.001
White women	4.9	7.3	4.8	<.001	.29	<.001
Black women	4.1	6.4	4.1	<.001	.67	<.001
Hispanic women	5.4	9.5	5.0	<.001	.13	<.001

Note. PTCA = percutaneous transluminal coronary angioplasty; CABG = coronary artery bypass grafting.

**TABLE 3—In-Hospital Mortality Percentages, by Race, Gender, and Insurance Status**

	Medicare Only (Group 1)	Medicare With Private Insurance (Group 2)	Medicare With Public Insurance (Group 3)	Group Comparisons (P)		
				1 vs 2	1 vs 3	2 vs 3
Overall	17.0	14.0	16.1	<.001	.02	.002
White men	16.9	13.7	14.5	<.001	<.001	.04
Black men	15.6	11.7	13.8	<.001	.003	.01
Hispanic men	13.4	8.7	11.3	<.001	.01	.004
White women	20.6	15.6	18.4	<.001	.01	<.001
Black women	19.6	13.2	17.5	<.001		
Hispanic women	16.6	13.4	15.0	.001	.03	.004

(Table 4). Overall, both gender and race were significantly associated with procedure use and in-hospital mortality; Whites and men were more likely to undergo procedures than Blacks and women. However, there was no difference between Whites and Hispanics, although univariate analyses showed that Hispanics had higher revascularization rates and lower in-hospital mortality rates.

The univariate analyses showed that Whites had the highest in-hospital mortality rates. After adjustment for other characteris-

tics, there was no difference in mortality rates between Whites and Hispanics, and the rates among both of these groups were lower than those among Blacks. In comparison with Medicare-only patients, those with supplemental private insurance exhibited significantly more frequent revascularization and lower in-hospital mortality rates; those with supplemental public insurance exhibited revascularization and in-hospital mortality rates similar to those of the Medicare-only group. Stratification according to race/ethnicity

revealed similar within-group associations of insurance status with revascularization use and in-hospital mortality (Table 4).

**DISCUSSION**

The principal finding here was that most (57.7%) Medicare recipients (at least those hospitalized for acute myocardial infarction) have supplemental insurance (either private or public). However, only supplemental private insurance seems to affect type of hospital care and short-term survival. The exception to this generalization is that, among Whites, those with supplemental public insurance were more likely to undergo PTCA than those with only Medicare coverage. Furthermore, after adjustment for insurance status and risk factors, racial differences in cardiac procedure use persisted. In view of the wide disparities in insurance coverage among younger Americans,<sup>9,12</sup> these data indicate that universal availability of health insurance does not eliminate socioeconomic disparities in health service use and outcomes for older Americans.

Previous studies have repeatedly shown that use of medical care in the United States is related to health insurance status.<sup>13,14</sup> In the case of the elderly, Medicare provides a basic level of access to health care. Still, one study showed that individuals who have Medicare and supplemental public insurance coverage and individuals who have Medicare coverage only are twice as likely as those who have supplemental private insurance to have unmet medical needs (including needs related to immunization, dental care, prescription medicine, eyeglasses, and mental health).<sup>15</sup> However, this investigation did not address in-hospital service.

The present study showed that Medicare cannot universally provide the health care needed by hospitalized myocardial infarction patients. Therefore, our initial hypothesis—that Medicare coverage supplemented by private insurance would not result in improvements in regard to either revascularization or in-hospital mortality rates among patients hospitalized after a myocardial infarction—was not confirmed. Moreover, the fact that the groups who, for the most part, lacked private supplemental insurance coverage were Blacks,

**TABLE 4—Procedure Use and Mortality Odds Ratios, by Race, Gender, and Insurance Status: Logistic Regression Models**

	Odds Ratio (95% Confidence Interval)		
	Model 1: PTCA	Model 2: CABG	Model 3: Mortality
Overall			
Race			
Black vs White	0.56 (0.50, 0.62)	0.44 (0.40, 0.50)	1.19 (1.11, 1.27)
Hispanic vs White	1.01 (0.92, 1.10)	0.69 (0.62, 0.77)	0.96 (0.89, 1.03)
Gender (men vs women)	1.14 (1.08, 1.20)	1.55 (1.46, 1.64)	0.89 (0.85, 0.93)
Insurance			
Private plus vs Medicare only	1.69 (1.60, 1.79)	1.53 (1.44, 1.63)	0.77 (0.73, 1.80)
Public plus vs Medicare only	1.05 (0.97, 1.14)	1.05 (0.95, 1.16)	0.95 (0.90, 1.01)
Non-Hispanic Whites			
Gender (men vs women)	1.15 (1.09, 1.22)	1.60 (1.51, 1.70)	0.90 (0.86, 0.94)
Insurance			
Private plus vs Medicare only	1.85 (1.75, 1.97)	1.78 (1.67, 1.89)	0.75 (0.72, 0.79)
Public plus vs Medicare only	1.18 (1.07, 1.30)	1.09 (0.98, 1.21)	0.95 (0.89, 1.02)
Non-Hispanic Blacks			
Gender (men vs women)	0.96 (0.80, 1.16)	1.06 (0.86, 1.30)	0.87 (0.76, 0.99)
Insurance			
Private plus vs Medicare only	1.74 (1.41, 2.15)	2.00 (1.58, 2.53)	0.78 (0.66, 0.92)
Public plus vs Medicare only	0.92 (0.73, 1.16)	0.83 (0.64, 1.08)	1.07 (0.93, 1.23)
Hispanics			
Gender (men vs women)	1.05 (0.88, 1.25)	1.36 (1.10, 1.68)	0.80 (0.69, 0.93)
Insurance			
Private plus vs Medicare only	1.88 (1.48, 2.38)	2.03 (1.51, 2.72)	0.72 (0.55, 0.93)
Public plus vs Medicare only	1.01 (0.84, 1.23)	0.90 (0.71, 1.14)	0.87 (0.75, 1.02)

Note. PTCA = percutaneous transluminal coronary angioplasty; CABG = coronary artery bypass grafting. In model 1, PTCA was the dependent variable; in model 2, CABG was the dependent variable; and in model 3, in-hospital death was the dependent variable. Other model variables were as follows: age, diabetes comorbidity, hypertension comorbidity, length of hospital stay, complications of congestive heart failure, previous myocardial infarction, admission status, and location of myocardial infarction.

Hispanics, and women suggests that other sociodemographic differences existed among patients with private insurance coverage.

Previous research on treatment of myocardial infarction has shown that patients with private insurance are more likely to undergo revascularization than those with Medicare, Medicaid, or no insurance.<sup>13,16</sup> Such analyses are often confounded by age because, by definition, Medicare beneficiaries are older than 65 years. It has been reported that older patients are less likely to be reperfused than younger patients.<sup>17</sup> A report of the National Registry of Myocardial Infarction showed that Medicare/Medicaid patients, in comparison with privately insured patients, undergo fewer reperfusion procedures, undergo fewer invasive cardiac procedures, and have longer hospitalizations. However, in this comparison,

which included all age groups, Medicare patients were older and of more advanced clinical status.<sup>18</sup>

The fact that differences in PTCA and CABG rates use between Whites and Blacks persisted in each insurance group and among both men and women suggests that even with universal medical insurance in place, individuals who are socioeconomically disadvantaged are less likely to receive the services they need. In fact, the differences in revascularization use among White and Black patients observed here were generally similar to those reported in a previous study involving the overall adult population (i.e., individuals 35 years or older); in that study, White/Black ratios in regard to PTCA and CABG use were 1.63 and 1.55, respectively.<sup>19</sup>

The finding that patients with Medicare-only coverage were more likely than patients in the other insurance groups to remain in the hospital more than 7 days was consistent with an earlier report indicating that, in comparison with patients with good access to health care, those with poor access exhibit significantly longer hospital stays and poorer health outcomes in regard to the condition requiring hospitalization.<sup>20</sup> Moreover, Medicare patients with supplemental private insurance were more likely than patients with Medicare only and those with supplemental public insurance to have had a previous myocardial infarction, suggesting in turn that these patients were more likely to survive the first event. Overall, women underwent fewer revascularization procedures than men, and Blacks underwent fewer procedures than White or Hispanic patients, regardless of insurance status. These associations persisted after adjustment for sociodemographic characteristics, comorbid conditions, complications, length of hospital stay, previous myocardial infarction, admission status, and location of myocardial infarction.

While in-hospital mortality rates were highest among Whites and lowest among Hispanics, adjustment for other characteristics revealed that Whites and Hispanics exhibited similar in-hospital mortality, and the rates for both of these groups were lower than those among Blacks. However, gender-specific mortality differences persisted after adjustment for other characteristics.

The strengths of SPARCS are its large size, standardized data collection methodology, and individualized database. However, this study was limited to the administrative database, which provides minimal clinical details and does not include diagnostic study results or information on use of thrombolytic therapy or particular medications. No long-term follow-up information is available. Also, our study included only patients admitted to New York City hospitals, limiting extrapolation to the overall US population. In addition, federal, military, Department of Veterans Affairs, and institutional hospitals were not included. Therefore, our results cannot be generalized to all hospitals in the United States.

In summary, the results of this study suggest that purchase of supplemental private

health insurance leads to increased use of specialized medical care and hospital survival among Medicare patients hospitalized with acute myocardial infarction. In view of the marked insurance-linked disparities in services and outcomes observed among younger Americans, it seems likely that universal health insurance coverage involving Medicare alone will not reduce health disparities among older Americans. Moreover, since sociodemographic characteristics, including gender and race, continue to be associated with receipt of health services as well as overall in-hospital mortality, it is clear that equalizing insurance coverage for hospital services through Medicare does not, in itself, eliminate all health disparities. ■

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#### Contributors

J. Fang and M. H. Alderman conceived the study, contributed to its design and to interpretation of the data, and revised the article. J. Fang also analyzed data and drafted the article.

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#### Human Participant Protection

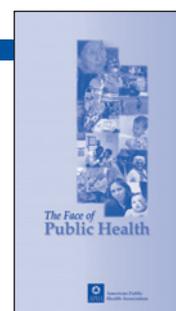
No protocol approval was needed for this study.

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# Delays and Unmet Need for Health Care Among Adult Primary Care Patients in a Restructured Urban Public Health System

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The Institute of Medicine's Committee on Monitoring Access to Personal Health Care Services defines appropriate access to health care as "the timely use of personal health services to achieve the best possible health outcome."<sup>1(p4)</sup> Previous studies have found that uninsured adults are more likely to delay seeking care than those who are insured,<sup>2-4</sup> less likely to receive preventive and screening services,<sup>5</sup> and less likely to be referred by primary care physicians for other health services.<sup>6</sup> Delayed or nonreceipt of medical care may result in more serious illness for the patient, increased complications, a worse prognosis, and longer hospital stays.<sup>4,5,7-9</sup>

Financial problems are only 1 of the barriers people face in obtaining the health care they need.<sup>10</sup> Studies support the models of health care utilization that suggest that other factors also enable or impede an individual's ability to obtain medical care.<sup>11,12</sup> These include health beliefs, cultural practices, language barriers, social networks and contacts, and the availability and accessibility of medical care in the community.<sup>11,12</sup> Thus, uninsured populations composed of ethnically diverse individuals pose challenges in terms of providing/receiving needed care in a timely fashion. In many urban areas, the population is ethnically diverse with a large population of uninsured adults and children. The provision of needed medical care to low-income people residing in large urban areas continues to be a challenge.<sup>13</sup>

For publicly funded health care systems to provide equitable access to needed health care, information about the delays patients experience in receiving care and their unmet needs for medical care is critical. The Los Angeles County Department of Health Services (LAC-DHS) serves a crucial role in the provision of health care to many adults and children in Los

**Objectives.** We estimated the prevalence and determinants of delayed and unmet needs for medical care among patients in a restructured public health system.

**Methods.** We conducted a stratified cross-sectional probability sample of primary care patients in the Los Angeles County Department of Health Services. Face-to-face interviews were conducted with 1819 adult patients in 6 languages. The response rate was 80%. The study sample was racially/ethnically diverse.

**Results.** Thirty-three percent reported delaying needed medical care during the preceding 12 months; 25% reported an unmet need for care because of competing priorities; and 46% had either delayed or gone without care.

**Conclusions.** Barriers to needed health care continue to exist among patients receiving care through a large safety net system. Competing priorities for basic necessities and lack of insurance contribute importantly to unmet health care needs. (*Am J Public Health.* 2004;94:783-789)

Angeles County, servicing more than 600 000 patients per year. Los Angeles County is remarkable for the racial/ethnic diversity of the population and for the proportion of uninsured individuals who reside there—almost 2 million in 2002.<sup>14</sup> In 1995, LAC-DHS faced serious financial problems that prompted restructuring of the provision of hospital-based and ambulatory care services. One major reorganizing strategy was the improvement of ambulatory care through greater emphasis on primary care services. This was implemented through the formation of partnerships between LAC-DHS and existing community clinics that served as part of the safety net.

As a result of the restructuring, LAC-DHS comprised 4 types of facilities providing primary care services: comprehensive health centers, personal health centers, hospital outpatient clinics, and public/private partnership clinics. This restructuring of the ambulatory care system provided an important opportunity to assess access to health care for patients in the primary care network.

We studied patients receiving primary medical care services in this system to gain a

better understanding of why patients delay care or have unmet health care needs. The aims of this article are to (1) estimate the prevalence of delayed and unmet health care needs among adult patients of the LAC-DHS within the preceding 12 months, (2) identify their perceived barriers for delayed care, and (3) identify factors that put these patients at increased risk for having delayed care and unmet health care needs.

## METHODS

### Study Design

We employed a cross-sectional study utilizing probability sampling and survey methods to conduct this study. Although full details of the study design and sampling method have been described elsewhere,<sup>15</sup> we provide a short overview. Our target population was patients receiving medical care at primary care clinics in the LAC-DHS primary care network. Patients were sampled from among each of the 8 geographic areas within Los Angeles County known as service planning areas.

## Sampling

The goal was to complete approximately 2400 patient interviews. The sample was selected probabilistically in 3 stages: clinic facility, session within facility, and patient within session. By recruiting patients at clinics, we ensured that all patients receiving services from LAC-DHS primary care clinics were represented.

For the first stage, the LAC-DHS facilities were categorized into 4 distinct strata: 6 comprehensive health centers, 5 hospital outpatient centers, 19 personal health centers, and 85 public/private partnership program sites. One fourth of the patient sample was allocated to each stratum, an allocation designed to achieve 80% power ( $\alpha=.01$ ) for detecting a small difference (0.2 of a standard deviation) between strata. We included all clinics designated as providing primary care services, specifically: general internal medicine, general pediatrics, family medicine, and urgent care/walk-in. These clinics served as the intake points for the recruitment of patients. For comprehensive health centers, personal health centers, and hospital outpatient centers, we sampled all facilities with certainty. For public/private partnership program clinics, we sampled 20 facilities with probabilities proportional to estimated size; to ensure representation from all geographic areas of the county, the design specified at least 1 public/private partnership program facility from each service planning area.

In the second stage, we randomly sampled eligible sessions from the selected facilities. Each session was a combination of a facility and a time slot—the time slots were the combinations of week (1 through 16 for our 16-week study period), day of the week (Monday through Sunday), and time of the day (morning, afternoon, evening). Altogether, we sampled 327 sessions.

In the third stage, we employed systematic random sampling to select eligible patients from the sampled sessions. For this sampling, intervals were calculated from estimated case-loads for each facility and session.

## Eligibility

Patients were eligible to participate in the survey if they were aged at least 1 year, had received health care through the LAC-DHS system within 12 months preceding the date

of the interview, and were at the clinic for a medical visit (i.e., to be seen by a health care provider, not just for medication pickup). When the selected patient was a minor younger than 18 years, the child's parent or legal guardian acted as the proxy respondent for the child's interview. Patients were not eligible to participate if they did not speak 1 of the 6 languages included in the study (English, Spanish, Armenian, Chinese, Korean, or Tagalog) or were not able to participate (e.g., cognitive impairment).

## Data Collection

Data collection relied on face-to-face interviews and was performed over 16 weeks from mid-February to mid-June 1999. The interview was administered in 2 parts by trained bilingual interviewers in the waiting rooms or offices of the clinics and took approximately 40 minutes to complete. The main interview was completed before the patient saw the physician, and the postvisit interview was conducted after the patient had completed the medical visit. As part of the informed consent process, patients were offered \$10 for their participation.

## Response Rate

Of the 5331 patients enumerated, 3193 (60%) were found to be eligible. Ineligible patients included those with no prior county visits, children younger than 1 year, people at the clinic for other reasons, those who did not speak 1 of the study languages, patients interviewed previously, and minor children without a parent or guardian present. Among the eligible patients, 2564 completed the main interview and were included in the final sample—our response rate was therefore 80%; 15% refused to participate, and 4% terminated the interview before completion. About half each completed the survey in Spanish (52%) or English (47%) and less than 2% completed the survey in the other languages. Of the 2564 respondents, 745 represented pediatric patients. The analyses reported here are based on the 1819 adults who participated in the survey.

## Weighting for Sampling, Visit Frequency, and Nonresponse

The combined analysis weight was derived as the product of the overall sampling

weight (the product of the facility-level sampling weight, the session-level sampling weight, and the individual-level sampling weight), the nonresponse weight, and the visit frequency weight.<sup>15</sup>

## Survey Instrument

The instrument was developed from previously administered English- and Spanish-language survey items.<sup>16–22</sup>

## Outcome Variables

The 2 main outcomes were delayed and unmet need for medical care within the past year. Delayed care was measured by the following: "In the past 12 months, have you ever put off going to the doctor for medical care because . . . You couldn't get off work? You were too sick? You didn't have a way to get there? You had responsibilities to take care of someone? You were afraid to leave home because of personal safety? You had other more important things to take care of?" Unmet need for health care because of competing priorities was measured by the following: "In the last 12 months, have you ever had to go without health care at a county clinic because you had to spend your money for food, clothing, housing, etc.?"

## Independent Variables

The 11 independent variables included age, gender, race/ethnicity, income, education, immigration status, coverage for health care, 1 or more children younger than 18 years at home, 1 or more other adults aged 65 years and older at home, 3 or more visits for health care during the preceding year, and perceived health status. Patients were categorized as Hispanic/Latino, non-Hispanic/Latino Black, non-Hispanic/Latino White, Asian/Pacific Islander, and Other based on self-identification. Income categories were constructed to reflect the skew of the patients toward very low annual incomes (<\$5000, \$5001 to \$10 000, \$10 001 to \$15 000, and >\$15 000). Education is presented as a dichotomous variable to reflect graduation from high school. Patients were categorized as immigrants if they reported a country other than the United States as their place of birth. Coverage for health care was a 4-level variable: Medicaid, private insurance, other cov-

erage (including publicly funded nontransferable programs), and no coverage. Health status was measured with a widely used single item with 5 response options: excellent, very good, good, fair, or poor.

### Statistical Analyses

We calculated the overall rate of delayed care (i.e., patients who responded yes to 1 or more of the 6 reasons described previously) and the specific rates for the reasons that patients delayed care. In addition, we calculated the rate for unmet need for health care due to competing priorities. We estimated the bivariate associations between delayed care and unmet need for health care and patient characteristics—gender, age, race/ethnicity, income, education, immigration status, coverage for health care, 1 or more children younger than 18 years at home, 1 or more adults aged 65 years and older at home, and health status. To estimate the unique associations between patient characteristics and delayed and unmet health care needs, we performed multivariate logistic regression analyses. All variables included in the bivariate analyses were included in the multivariate model. We assessed our explanatory variables for the presence of significant multicollinearity and found none. All analyses were performed using SAS, version 8,<sup>23</sup> and Stata.<sup>24</sup>

## RESULTS

The mean age of the sample was 44 years. Hispanics/Latinos constituted the largest racial/ethnic group (56%). Women made up over two thirds of the sample. The median household income was within the income category of \$5001 to \$10 000 (Table 1). Fifty-five percent of adults had not graduated from high school, 62% of participants were born outside the United States, 82% were not employed full time, and 69% were uninsured for health care. The median health status was fair.

### Delayed Care

Thirty-three percent of patients reported that they had delayed seeking medical care at least once during the preceding 12 months, for the following reasons (multiple reasons allowed): 13% could not take time off from work, 12% had to care for someone else, 12% did not have transportation to get to

**TABLE 1—Sample Characteristics of Adult Patients (n = 1819) in Los Angeles County Department of Health Services Clinics: 1999**

	%
Age, y (mean = 44)	
18–25	11
26–40	33
41–64	51
≥ 65	5
Gender	
Male	31
Female	69
Race/ethnicity	
Hispanic/Latino	56
Black	23
White	17
Asian/Pacific Islander	2
Other	2
Income, \$	
≤ 5000	38
5001–10 000	22
10 001–15 000	19
> 15 000	21
Education	
High school graduate	45
Not high school graduate	55
Immigration status	
US-born	38
Non-US-born	62
Employment status	
Employed full time	19
Employed part time	21
Not employed	61
Coverage for health care	
Medicaid	14
Private insurance	5
Other coverage	12
None	69
Children in household	
≥ 1 children < 18 y	56
No children < 18 y	44
Elderly in household	
≥ 1 adults ≥ 65 y	15
No adults ≥ 65 y	85
Health status	
Poor	9
Fair	41
Good	30
Very good	15
Excellent	6

their appointment, 9% were too sick, 6% had other or more important things to do, and 3% were afraid for their personal safety. We found significantly higher rates for delayed care among females, US-born individuals, employed patients, and those with poor health status. There was no significant difference in rates of delayed care for people who had made or had not made 3 or more visits to a physician during the preceding year (Table 2). Women were more likely than men to attribute their delayed health care to being too sick (10% vs 6%,  $P < .05$ ) and having responsibilities for taking care of other individuals (14% vs 8%,  $P < .01$ ). Non-US-born patients were less likely than US-born patients to report being too sick (7% vs 11%,  $P < .01$ ) or having problems with transportation (10% vs 14%,  $P < .05$ ) as reasons for delaying medical care. Patients employed full time had the highest rate for delaying care because of not being able to take time off work, and this rate was significantly different from that of patients who were not employed (27.1% vs 5.7%,  $P < .001$ ). Furthermore, patients who were unemployed were more likely than patients who were employed full time to report delaying care because of problems with transportation (13.8% vs 7.1%,  $P < .05$ ).

In multivariate analyses, we found that only gender was independently associated with delaying health care (Table 3). Women were more likely to report having delayed seeking care when we controlled for age, race/ethnicity, income, immigration status, education, employment, coverage for health care, children living in the household, persons aged 65 years or more living in the household, and health status.

### Unmet Need

Twenty-five percent of patients indicated that they had gone without needed medical care because they had to spend their money for food, shelter, or clothing. In bivariate analyses, females, immigrants, and uninsured patients had higher rates of unmet need for health care (Table 2). In addition, patients who reported poor health status had higher rates of unmet need for health care than did patients reporting better health status. Patients with persons aged 65 years and older

**TABLE 2—Bivariate Analyses for Delayed Care and Unmet Need for Health Care Among Adult Patients (n = 1819) in Los Angeles County Department of Health Services Primary Care Clinics: 1999**

	Delayed Medical Care for at Least 1 of 6 Reasons, %	Had Unmet Need for Medical Care: Money Spent for Food, Housing, Clothing,
Age, y		
18–25	32.4	22.7
26–40	34.1	26.8
41–64	34.4	26.2
≥ 65	19.9 NS	10.0**
Gender		
Male	27.4***	20.8**
Female	36.1	27.2
Race/ethnicity		
Hispanic/Latino	31.4	29.0
Black	34.2	21.7
White	38.9	19.4
Asian/Pacific Islander	18.8	42.2
Other	22.1 NS	24.7 NS
Income, \$		
≤ 5000	34.0	26.0
5001–10 000	35.5	26.7
10 001–15 000	36.9	30.5
> 15 000	30.1 NS	20.2 NS
Education		
High school graduate	31.1	27.5
Not high school graduate	36.1 NS	22.3 NS
Immigration status		
US-born	37.8	19.5
Non-US-born	30.6**	28.5***
Employment status		
Employed full time	38.5	25.9
Employed part time	37.9	25.2
Not employed	30.1**	24.8 NS
Coverage for health care		
Medicaid	28.8	11.8
Private insurance	39.0	7.2
Other coverage	32.6	19.5
None	34.8 NS	29.2†
Children in household		
≥ 1 children < 18 y	31.8	26.1
No children < 18y	35.5 NS	24.0 NS
Elderly in household		
≥ 1 adults ≥ 65 y	31.1	15.8
No adults ≥ 65 y	33.3 NS	26.1***
3 or more physician visits		
Yes	34.1	24.7
No	32.8 NS	25.5 NS
Health status		
Poor	45.7*	41.6†
Fair	34.1	28.5
Good	29.6	21.6
Very good	30.1	16.7
Excellent	38.7	17.9

Note. NS = not significant.  
\**P* < .1, \*\**P* < .05, \*\*\**P* < .01, †*P* < .001.

living at home had lower rates of unmet need for health care.

After adjustment for sociodemographic and other patient characteristics in multivariate analyses, uninsured patients were more likely than individuals with any type of coverage for medical care to have unmet needs for health care due to competing priorities—having to pay for food, shelter, or clothing (Table 4). Patients in poor health were at increased risk, whereas individuals who had an elderly relative living with them were at reduced risk for unmet health care needs.

Overall, 46% had either delayed care or had an unmet need for health care, and almost 13% of patients had both delayed care and had an unmet need for health care within the past 12 months.

## DISCUSSION

This study demonstrates the existence of significant delays and unmet health care needs among low-income and uninsured patients who have taken some advantage of a comprehensive public health system that serves as a safety net for patients with no place else to obtain needed health care. However, even among this sample, taken from those who have used the safety net system at least once over a 12-month period, a substantial portion reported that they had delayed receiving needed medical care during that time. Because of delays and competing priorities, these patients are at increased risk for limited receipt of necessary health care.

One quarter of the patients in this study had not received needed medical care during the preceding year because the money they had was needed to pay for food, shelter, or clothing. Patients uninsured for health care and those reporting the worst health status were the most likely to have delayed needed medical care due to competing priorities. In the National Health Interview Survey, health insurance status was related to every access-to-care indicator.<sup>25</sup> People without health insurance were the most likely to have an unmet need for health care and to lack a usual source of care. Other research has shown that the lack of health insurance acts as a major barrier to receipt of needed health care services.<sup>4,5,8,26–29</sup>

**TABLE 3—Determinants (Multivariate) of Delayed Care Among Adult Patients (n = 1454) in Los Angeles County Department of Health Services Primary Care Clinics: 1999**

	Delayed Care	
	Relative Risk <sup>a</sup>	95% CI
Age, y		
18–25	0.92	0.60, 1.33
26–40	0.99	0.78, 1.23
41–64	...	...
≥ 65	0.77	0.43, 1.21
Gender		
Male	...	...
Female	1.40	1.16, 1.65*
Race/ethnicity		
White	1.08	0.80, 1.39
Black	1.12	0.77, 1.52
Hispanic/Latino	...	...
Asian/Pacific Islander	0.64	0.24, 1.38
Other	0.73	0.30, 1.45
Income, \$		
≤ 5000	...	...
5001–10 000	0.96	0.76, 1.19
10 001–15 000	1.09	0.81, 1.40
> 15 000	0.88	0.68, 1.10
Immigration status		
Immigrant	0.90	0.66, 1.18
Not immigrant	...	...
Education		
High school graduate	...	...
Not high school graduate	0.91	0.72, 1.12
Employment status		
Employed full time	1.24	0.98, 1.53
Employed part time	1.12	0.85, 1.41
Not employed	...	...
Coverage for health care		
Medicaid	0.85	0.60, 1.15
Private insurance	1.24	0.80, 1.74
Other coverage	0.88	0.66, 1.13
None	...	...
Children in household		
No children < 18 y	...	...
≥ 1 children < 18 y	0.86	0.69, 1.05
Elderly in household		
No adults ≥ 65 y	...	...
≥ 1 other adults ≥ 65 y	0.97	0.71, 1.28
Health status		
Poor	1.17	0.85, 1.53
Fair/good	...	...
Very good	0.87	0.62, 1.16
Excellent	1.22	0.81, 1.69

Note. CI = confidence interval; ... = reference group.

<sup>a</sup>Multivariate logistic regression model to examine joint effects for age, race/ethnicity, income, immigration status, education, employment, coverage for health care, children living in the household, elderly persons living in the household, and health status.

\**P* < .001.

Thirty three percent of patients reported 1 or more reasons for delaying their health care during the preceding year, although we do not know the length of the delays. However, because these findings are among patients who had received medical care at least once during the preceding year, they may actually underestimate the extent of the problem of the entire group of people who delayed care because of perceived barriers or competing priorities. The finding that women were at elevated risk for delaying needed medical care supports results from prior studies.<sup>30–33</sup> Women in this study were more likely than men to report that taking care of others had caused them to delay seeking health care for themselves. Although women are the main users of the medical system, they are most often responsible for providing care to family members and friends.<sup>30,34</sup> Thus, programs to encourage women to obtain needed medical care might have increased effectiveness if child care or elder care services had been provided on site at the health care facilities; if care for multiple family members had been coordinated; or if temporary caregivers had been identified.

Income was not significantly associated with delayed and unmet needs for health care. The lack of significant findings may be due to a “floor effect” as the population sampled and served by the LAC-DHS is by definition a low-income population. However, the impact of finances on delayed and unmet needs for medical care in the general population has been well documented.<sup>10,35</sup> Medical care through the LAC-DHS is not necessarily free but based on ability to pay. For those without resources it is free. Indeed, it is an indication of the pervasiveness of financial barriers to medical care that individuals at different income levels may experience varying tradeoffs with respect to health care and competing priorities.

Although many patients reported reasons for delayed care that can only be resolved by reducing socioeconomic inequalities, other causes for delayed or unmet health care needs may be addressed by changing how LAC-DHS delivers care. Additional restructuring might include the expansion of clinic hours, the implementation of appointment reminder systems at all county clinics, trans-

**TABLE 4—Determinants (Multivariate) of Unmet Need for Health Care Among Adult Patients (n = 1455) in Los Angeles County Department of Health Services Primary Care Clinics: 1999**

	Unmet Need for Care <sup>a</sup>	
	Relative Risk <sup>b</sup>	95% CI
Age, y		
18–25	1.02	0.60, 1.59
26–40	1.06	0.80, 1.37
41–64	...	...
≥ 65	0.91	0.42, 1.68
Gender		
Male	...	...
Female	1.22	0.91, 1.58
Race/ethnicity		
Hispanic/Latino	...	...
Black	0.83	0.48, 1.31
White	0.86	0.60, 1.18
Asian/Pacific Islander	1.27	0.48, 2.44
Other	0.69	0.26, 1.52
Income, \$		
≤ 5000	...	...
5001–10 000	1.10	0.76, 1.52
10 001–15 000	1.09	0.74, 1.52
> 15 000	0.75	0.51, 1.06
Immigration status		
Immigrant	1.02	0.70, 1.44
Not immigrant	...	...
Education		
High school graduate	...	...
Not high school graduate	1.26	0.98, 1.58
Employment status		
Employed full time	1.17	0.80, 1.61
Employed part time	1.04	0.75, 1.39
Not employed	...	...
Coverage for health care		
Medicaid	0.40	0.26, 0.61**
Private insurance	0.30	0.11, 0.76*
Other coverage	0.62	0.44, 0.86*
None	...	...
Children in household		
≥ 1 children < 18 y	1.01	0.74, 1.34
No children < 18 y	...	...
Elderly in household		
≥ 1 other adults ≥ 65 y	0.55	0.34, 0.86*
No adults ≥ 65 y	...	...
Health status		
Poor	1.72	1.31, 2.17*
Fair/good	...	...
Very good	0.82	0.54, 1.20
Excellent	0.66	0.34, 1.19

Note. CI = confidence interval; ... = reference group.

<sup>a</sup>Unmet need for health care = money spent on housing, clothing, or food rather than medical care.

<sup>b</sup>Multivariate logistic regression model to examine joint effects for age, race/ethnicity, income, immigration status, education, employment, coverage for health care, children living in the household, elderly persons living in the household, and health status.

\**P* < .01, \*\**P* < .001

portation to, from, and between county facilities, and the availability of comprehensive family care at a single location.

These findings represent an important critical analysis in the development of a system for ongoing data collection and evaluation to improve the public health care programs. Important findings with regard to barriers and use of care have been identified that will be used to improve patients' access to care. A major strength of this study is that the sample is representative of primary care users within the LAC-DHS primary care network. In addition, face-to-face interviews were performed in multiple languages and included people for whom completion of a written survey would not have been possible because of low literacy rates. Face-to-face interviews also contributed to the high response rate (80%).

However, there are several limitations to this study. First, because the sampling design included only patients already receiving care through the LAC-DHS, it is not possible to assess delayed or unmet health care needs among people not currently visiting the medical facilities. Some of these people may be at greater risk for not receiving necessary medical care, even though they probably are not representative of all low-income uninsured individuals. Second, as with most survey-based research, the patients may have under- or overestimated the services they received. Errors of this type can lead to biased results in comparisons with other samples.

In conclusion, this study should be considered the beginning of a critical analysis process that will allow urban public health care systems to assess the components of patient care, including the critical areas of access and barriers to care and unmet needs for health care. Clearly, barriers exist for a substantial portion of patients who have received medical care in a large public health system. Patients without any form of coverage for health care and those in the poorest health are at the greatest risk of having unmet needs for medical care due to competing priorities associated with activities of daily living. New programs need to be implemented that will have a positive impact on the number of providers within the urban public health care system, as well as an expansion in primary care services. Improved efficiencies in the provision of

health care is one answer to the growing population of low-income and uninsured individuals who rely on publicly funded systems of care. Another answer is the expansion of insurance programs that would allow people to seek care away from the safety net. ■

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### Contributors

All authors were involved in the initial project development including study design, development of the questionnaires, data analysis, and the writing of the article. A. Diamant was responsible for the implementation and oversight of data collection, the initial draft of the article, and coordination of subsequent revisions. J. Fielding was involved in data analysis and the writing of the article. N. Duan was responsible for developing the sampling frame, statistical analysis and the writing of the article. S. Kim assisted with programming, statistical analysis, and the writing of the article.

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Institutional review board approval was received from the authors' home institutions and from all participating facilities as required.

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# Assessment of Household Food Security Among Food Stamp Recipient Families in Maryland

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In a country with an abundance of financial and nutritional resources, people continue to experience hunger. In 1999 and 2000, 10% of Americans experienced food insecurity and hunger.<sup>1,2</sup> Food insecurity exists whenever “the availability of nutritionally adequate and safe foods or the ability to acquire foods in socially acceptable ways is limited or uncertain.”<sup>3(p1560)</sup> The consequences of hunger and malnutrition on health status are of continuing concern for many Americans. Research has shown that experiencing food insecurity and hunger has implications for one’s physical and mental health status. Food insecurity has been shown to be associated with being overweight in women,<sup>4</sup> with poor health status among children,<sup>5</sup> with “negative academic and psychosocial outcomes” in children,<sup>6(p44)</sup> and with individuals having “higher odds of reporting poor/fair health” and “suffering from depression and distress.”<sup>7(p120)</sup>

In 1994, the US Department of Agriculture (USDA) developed the US Food Security Survey Module (FSSM), which directly measures the prevalence of household food insecurity and hunger. The mission of the USDA’s Food and Nutrition Service is “[t]o increase food security and reduce hunger in partnership with cooperating organizations by providing children and low-income people access to food, a healthful diet, and nutrition education in a manner that supports American agriculture and inspires public confidence.”<sup>8</sup> The USDA has also established a National Nutrition Safety Net (NNSN) to combat the problem of hunger in the United States. The NNSN is composed of economic and food assistance programs that are designed to promote and assist with the achievement of the mission of the Food and Nutrition Service.

Two viewpoints exist on the issue of food insecurity among low-income households. One might expect low-income households participating in an assistance program to ex-

**Objectives.** We assessed the relationship between food security status and various sociodemographic characteristics among households that include children and that receive food stamps.

**Methods.** A modified version of the US Food Security Survey Module was implemented by telephone survey with Maryland food stamp recipients.

**Results.** Of the 245 households, 66% experienced food insecurity. Food security status was associated with participation in the Special Supplemental Food Program for Women, Infants, and Children, the summer food program, and a food bank. Food security status was not associated with the number of months households received food stamps. There was no difference between the food security status of households living in urban and rural counties.

**Conclusions.** A gap exists between the food stamp support provided and some households’ nutritional and economic needs. (*Am J Public Health.* 2004;94:790–795)

perience some level of food insecurity, because they lack the resources necessary to access adequate amounts of nutritious food. In contrast, because the purpose of the programs of the NNSN is to provide economic and food assistance to low-income households, one might also expect a low prevalence of food insecurity among this population.<sup>8</sup>

Evidence indicates that food insecurity and hunger persist despite the efforts of government and private food assistance programs.<sup>9</sup> According to data from the 2000 Current Population Survey administered by the US Census Bureau, approximately 10% of US households are food insecure.<sup>2</sup> Single-female-headed households with children and all types of households with children experienced rates of food insecurity higher than the national average.<sup>1,2</sup> The same survey reported that among households with incomes below 130% of the poverty line (the eligibility requirement to receive food stamp benefits), approximately 47% and 42% of single female-headed households and households with children experienced food insecurity, respectively.<sup>2</sup> Data also show that the programs of the NNSN are not adequately meeting the nutrition needs of some households, most likely those at highest risk.<sup>2</sup> The purpose of this study was to measure the prevalence of

food insecurity and hunger experienced by a sample of food stamp recipients and to assess how food security status is related to sociodemographic characteristics, participation in economic and food assistance programs during the previous year, living in a rural or urban county, and the number of months in which the household received food stamps during the previous year.

## METHODS

### Participants

The target sample size of 278 food stamp recipients was established with the binomial sample size estimate equation,  $t^2 pq / (\text{desired confidence interval} / 2)^2 = \text{sample size } (n)$ , setting 4 as the approximate squared  $t$  value based on  $\alpha = .05$ , 50 as the hypothesized percentage of food security and the hypothesized percentage of food insecurity, and 6 as one half the desired 95% confidence interval. To be eligible for the study, participants had to be food stamp recipients who lived in the state of Maryland, spoke English, owned a telephone, and had at least 1 child. A random sample listing of 1545 food stamp recipients who met the criteria of eligibility was provided by the Maryland Department of Human Resources.

### Survey Instrument

The final version of our questionnaire included a consent form, a page of supplemental questions, and a modified version of the US FSSM. Minor revisions were made to improve the layout and the wording of the US FSSM without changing the meaning or sequence of the questions, to make the questionnaire more user friendly. Questions were rewritten from the first person (I or we) to the second person (you). A version of the US FSSM containing only the modifications to the layout was validated by research conducted among 259 participants of the Special Supplemental Food Program for Women, Infants, and Children (WIC) in Maryland (C. Tuttle, C. Oberholser, unpublished data; C. Tuttle, M. Nord, unpublished data, Spring 2001). The supplemental questions pertained to sociodemographic characteristics, additional public or private programs used within the past year, number of months in which the participants received food stamps during the past year, and form of transportation used most frequently. (In this article, food bank refers to a food bank, pantry, or soup kitchen.) Sociodemographic characteristics included age, sex, marital status, number of children in the household, number of extended family members living in the household, and ethnicity. County of residence and income level were based on information provided by the Maryland Department of Human Resources.

### Data Collection

The study design and questionnaire were approved for implementation by the University of Maryland institutional review board. The food stamp recipients were randomly contacted by telephone from September through December of 2001 and were asked to participate in the research project. The survey took approximately 15 minutes to complete, and the interview times ranged from 10 to 30 minutes. As an incentive, participants were automatically entered into a monthly raffle for \$100 worth of gift certificates at a local grocery store. Approximately 650 of the telephone numbers for 1545 recipients were not in service, were disconnected, or were wrong numbers. Of the 327 households contacted, 81 refused to participate and 246 agreed to participate. One person who was in-

terviewed did not meet the criteria of eligibility and was eliminated from the study. The final sample size was 245. The responses to the telephone interview were entered into a database with Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, Ga).

### Data Analysis and Statistics

Rasch analysis, performed by the USDA Economic Research Service, validated the standard methods of measuring food security used in our study.<sup>10</sup> Households were categorized by food security status with methods outlined by the USDA.<sup>10</sup>

The level of significance for all statistical tests was  $P < .05$ . Chi-square contingency table analyses and backward stepwise logistic regression analyses were used to examine the relationship between sociodemographic variables and food security status. Chi-square analysis was used to examine the relationships between food security status and marital status of respondent, ethnicity of respondent, and past-year participation by any member of the household in each of the programs or services included in the questionnaire. Because preliminary analysis indicated that sociodemographic variables did not significantly contribute to the model, these were eliminated from the logistic regression. The full model used in the multiple logistic regression included food insecurity as the dependent variable and participation in economic and food assistance programs as the independent variables. The independent variables included participation in the WIC, summer food, or school breakfast or lunch programs; receipt of temporary cash assistance; and use of a food bank. After backward stepwise logistic regression analyses, the final model (simple logistic regression) included food insecurity as the dependent variable and use of a food bank as the independent variable. Of the possible correlations between participating in the 5 assistance programs, the highest correlation was  $r = .185$ . Thus, it was acceptable to assume that high correlation between program participation in various programs was not a problem and did not affect the significance of the results in the backward stepwise logistic regression model.

Spearman's correlation was used to examine the association between the number of

months in the past year a household received food stamps benefits and the FSSM score. Chi-square analysis was used to compare the prevalence of food security between households living in urban and rural counties in Maryland. Counties were classified into rural or urban counties according to the USDA rural-urban continuum codes.<sup>11</sup> Counties with code 0 were considered urban (central counties of metropolitan areas with a population of 1 million or more), and those with codes 1 through 7 were considered rural (fringe counties of metro areas with a population of 1 million or more and counties with a population of less than 1 million).<sup>11</sup> This classification corresponds with the US Census Bureau urban and rural classification system. An urbanized area is defined as core census blocks with a population density of at least 1000 people per square mile and of surrounding census blocks with an overall density of at least 500 people per square mile.<sup>12</sup> With 2 exceptions, all of the counties classified as urban in our study had population densities greater than 1000 people per square mile in 1990.<sup>11</sup> The other 2 counties had population densities of approximately 400 and 750 people per square mile. The remainder of the counties classified as rural in our study all had population densities of fewer than 500 people per square mile.<sup>11</sup>

## RESULTS

### Respondent and Household Characteristics

A majority of the respondents were single, female, and of African American ethnicity (Table 1). Of this sample of low-income families with children, 75% of households received free or reduced-price school breakfast or lunch. Thirty-four percent of the households participated in WIC, 33% received temporary cash assistance, 12% participated in the summer food program for children, and 18% had accessed a food bank within the past year (Table 2).

### Food Security Status

Of the 245 participants, 66% of the households experienced some level of food insecurity. Only 34% of our sample was identified

**TABLE 1—Sociodemographic Characteristics of Study Respondents**

Characteristic	No. (%) or Mean	SEp or SEM	n
Ethnicity			245
African American	157 (64)	3.1	
White	79 (32)	3.0	
Other	9 (4)	1.1	
Gender			245
Female	237 (97)	1.1	
Male	8 (3)	1.1	
Marital status			245
Married	52 (21)	2.6	
Single	193 (79)	2.6	
Age, y			243
19–29	58 (24)	2.7	
30–39	86 (35)	3.1	
40–49	68 (28)	2.8	
50–70	31 (13)	2.2	
Age, y	37.7	0.68	243

Note. SEp = Standard error of the percentage.

as food secure. Thirty-eight percent experienced food insecurity without hunger, 21% experienced food insecurity with moderate hunger, and 7% experienced food insecurity with severe hunger.

**Association With Sociodemographic Characteristics**

No associations were found between food security status and marital status ( $P=.6600$ ), ethnicity ( $P=.2598$ ), participation in the school lunch or breakfast program ( $P=.2701$ ), or receipt of temporary cash assistance ( $P=.2886$ ). Significant associations were observed between food security status and participation in the following food assistance programs (compared with households not participating in the program): WIC ( $P=.0261$ ), summer food program ( $P<.0001$ ), or a food bank ( $P<.0001$ ).

Percentage of households participating in WIC decreased as food security status progressed toward severe hunger (Figure 1). However, households participating in a summer food program for children or in a food bank demonstrated the opposite association with food security status, as did participation in WIC. Percentage of households

**TABLE 2—Sociodemographic Characteristics of Study Households**

Characteristic	No. (%) or Mean	SEp or SEM	n
Participating in program			245
School breakfast/lunch	183 (75)	2.8	
WIC	84 (34)	3.0	
Temporary cash assistance	80 (33)	3.0	
Food bank	45 (18)	2.5	
Summer food program	29 (12)	2.1	
Other services	19 (8)	1.7	
Clothes closet or shelter	12 (5)	1.4	
School and WIC	55 (22)	2.6	
School and summer program	26 (11)	2.0	
WIC and food bank	15 (6)	1.5	
Food bank and summer program	11 (4)	1.3	
WIC and summer program	9 (4)	1.3	
Transportation			245
Bus	91 (37)	3.1	
Own car	90 (37)	3.1	
Friend or relative's car	37 (15)	2.3	
Walking	12 (5)	1.4	
Other	9 (4)	1.3	
Taxi	6 (2)	0.8	
No. of persons	3.88	0.089	235
No. of children	2.25	0.075	245
Monthly food stamp benefits, \$	235	8.1	245
Monthly household income, \$	760	28	245

Note. SEp = Standard error of the percentage; WIC = Special Supplemental Food Program for Women, Infants, and Children.

who participated in either of these 2 programs increased as food security status progressed toward severe hunger (Figure 1). In addition, backward stepwise logistic regression analysis showed that households that had used a food bank within the past year were nearly 3 times more likely to be food insecure compared with households that had not (odds ratio = 2.84,  $P=.0123$ ) (Table 3).

The households received food stamp benefits for an average of 9 months within the past year. Spearman correlation verified that the number of months in which each household received food stamps in the past year was not associated with food security score or with subsequent food security status ( $r=.0872$ ,  $P=.1840$ ). No significant difference in prevalence of food security was observed between households living in rural and in urban counties ( $\chi^2=.0071$ ,  $P=.9326$ ).

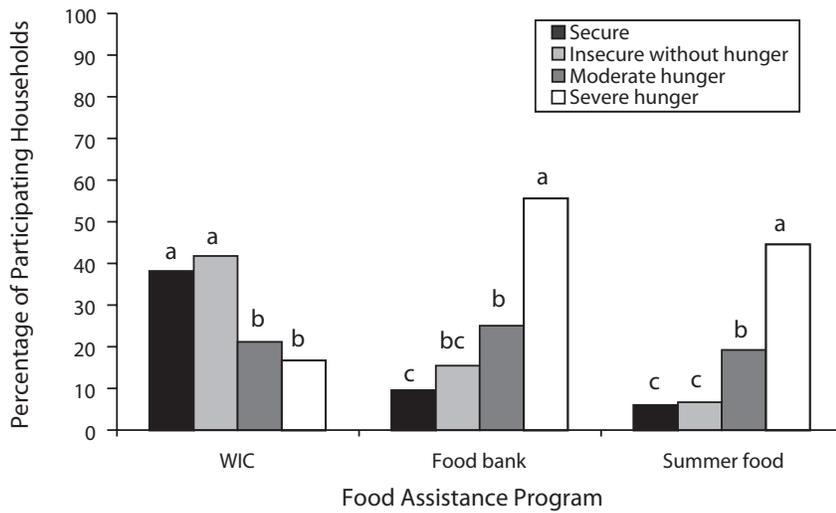
**Reasons for Food Insecurity**

Households experiencing food insecurity, with or without hunger, were asked, “Which of these statements best describes the food eaten in your household in the past 12 months?” 55 participants (34%) responded that they “sometimes did not have enough food to eat,” and 15 (9%) reported “often not having enough to eat.” Fifty-six participants (35%) did not always have the “kinds of food they wanted to eat,” although they had enough to eat. Not enough money to buy food was consistently and most frequently reported as the reason for not having enough food or the kinds of food they wanted to eat.

**DISCUSSION**

**Food Security Status**

A high proportion (66%) of food stamp-recipient households with children in this study experienced food insecurity. These



Note. WIC = Special Supplemental Food Program for Women, Infants, and Children. Overall *P* values (*n* = 245); WIC (*P* = .0261); food bank (*P* < .0001); summer food program (*P* < .0001). Bars with identical letters “a” through “c” are not significantly different within programs (*P* > .05).

**FIGURE 1—Percentage of households participating in food assistance programs, by food security status.**

**TABLE 3—Likelihood of Experiencing Food Insecurity Among Households Participating in Economic and Food Assistance Programs**

Program	Odds Ratio (95% Confidence Interval)	<i>P</i>
Food bank	2.84 (1.254, 6.409)	.0123
Summer food program	2.35 (0.849, 6.526)	.1001
Temporary cash assistance	1.35 (0.743, 2.434)	.3279
WIC	0.79 (0.451, 1.391)	.4168
School lunch/breakfast	1.10 (0.594, 2.051)	.7555

Note. WIC = Special Supplemental Food Program for Women, Infants, and Children.

rates of food insecurity and hunger are higher than those reported in the 1999 National Food Stamp Program Survey. The 1999 National Food Stamp Program Survey data (*n* = 2396) represent all households in the US population receiving food stamps. The results of the food stamp program survey indicated that approximately 28% of households expe-

rienced food insecurity without hunger, 17% experienced food insecurity with moderate hunger, and 5% experienced food insecurity with severe hunger, as compared with 38%, 21%, and 7%, respectively, observed in our study.<sup>13</sup> The higher prevalence of food insecurity and hunger in our study, compared with the National Food Stamp Program Survey data, may result from our sampling only families with children rather than all types of households or from the majority of our respondents’ being single and female.

**Association With Sociodemographic Characteristics**

We found identical rates of food insecurity in urban and rural counties. This finding provides convincing evidence that households in rural and urban counties in the state of Maryland experience food insecurity in equal proportions and that demographics normally used to identify a county as rural or urban did not have a significantly different influence on the prevalence of food insecurity.

In light of the fact that, according to national food stamp data, the average length of participation is less than 2 years and that 57% of households participate for 1 year or

less, it is not surprising that 52% of our respondents reported receiving benefits for all 12 months of the year.<sup>14</sup> Examination of the relationship between the number of months in which a household received food stamp benefits within the past year and food security score did not reveal significant associations between economic factors, participation, and food security status.

The percentage of families participating in WIC during the past year decreased as food security status progressed from secure to severe hunger (*P* = .0261). This finding is in contrast to the findings of Kendal et al.<sup>15</sup> and to other results from our study. Results from a study of 193 households with women and children in New York State demonstrated a significant progressive increase in the percentage of households participating in WIC as food insecurity worsened (*P* = .0001).<sup>15</sup> These results also conflict with the associations we found between food security status and participation in the summer food program or in food banks. These apparently conflicting results in our study may be explained by potential barriers to WIC participation, including WIC eligibility guidelines or by participants’ having problems accessing the WIC program (transportation issues, language barriers, etc.). Only pregnant women, postpartum women, and children younger than 5 years of age are eligible for WIC benefits. In addition, WIC clients must meet the criteria of having a household income less than 185% of the poverty level and of having an identified medical or nutritional risk factor. Eligibility for WIC cannot be directly examined from the data collected in our study, although the age of the oldest child in the household may reflect the household composition and therefore eligibility for the WIC program. Four percent (7 of 157 households) of households not participating in WIC reported that the oldest child was aged 5 years or younger, whereas 29% (23 of 78) of participating households reported that the oldest child was aged 5 years or younger. Households not participating that experienced hunger may have older children and therefore are not eligible for the WIC program. Other possible reasons for these results may include perceived difficulty in accessing the WIC benefits because of eligibility requirements and because of the

need to schedule an appointment—relative to participation, for example, in a food bank, where one can receive services without an appointment.

Additional concerns arise when the focus shifts to explaining the food security status of families not participating in food assistance programs. These results show that some families experiencing food insecurity and hunger are not participating in some of the programs of the National Nutrition Safety Net (NNSN), which are designed to alleviate hunger.<sup>8</sup> These families either are ineligible because of participant criteria or are not able to fully use the food assistance programs for other reasons. Some households may choose not to participate because they perceive a social stigma attached to participation in food assistance programs.

According to Venner et al.,<sup>9(p9–10)</sup> “emergency food program activity constitutes a unique barometer for gauging the paradox of hunger in a strong economy, and is evidence of the numbers of households and individuals for whom neither employment in a strong economy nor federal safety nets are providing the support necessary to ensure their food security.” In addition to the 18% of the households in this study that used a food bank in the past year, other indicators suggest that the food safety net is not providing sufficient support to some households. The high prevalence of food insecurity among these food stamp–recipient households, the fact that those households using a food bank within the past year were nearly 3 times more likely to be food insecure than those households not using a food bank, and the fact that respondents reported insufficient money as the primary reason for food insufficiency are indicators that a gap exists between the supplementary monetary benefits received from the food stamp program and the economic and nutritional needs of these households.

The results of this study show that the programs of the NNSN are not adequately providing for the economic and nutritional needs of some households. In addition to identifying that gaps exist in the NNSN, the issue of adequate wages and household income also needs to be addressed. This study did not directly measure employment status or wages earned, although one may speculate that em-

ployment status and the monetary value of wages are also factors contributing to the gap between the households’ needs and the services provided by food assistance programs.

### Limitations

The analysis and interpretation of these results is limited by our inability to calculate the number of households who are eligible to participate in each program. We cannot distinguish between nonparticipating households who do not qualify to receive benefits from a program and those that qualify but choose not to participate in the program.

The results of this study could be biased because of the fact that 650 of the telephone numbers were disconnected or a wrong number. However, because these households are most likely at high risk, this potential bias would mean that our results may actually underestimate the prevalence of food insecurity among this sample. Because of fluctuation in use of the food stamp program, all of the households interviewed were not receiving food stamp benefits at the time of interview. However, all of the households had received food stamp benefits sometime within the past year. Because the FSSM is based on the perception of the respondent, results could also be influenced by a respondent’s attitude during the interview or by recall bias.

### CONCLUSIONS

Research should be conducted to identify how the apparent gap in the NNSN can be decreased and eliminated. One possible starting point would be to assess how employment and wages contribute to food insecurity and hunger among low-income households, how the barriers to participation in food assistance programs can be decreased and eliminated, and the extent to which these food assistance programs provide nutritional support to participating at-risk populations.

Our results indicate that action needs to be taken to decrease the prevalence of food insecurity and hunger among food stamp recipients. Participation in career development programs would enhance employment status and improve economic status for some households. Further support—not restricted to economic support—should be given to single-

parent-headed households with children. State programs not only should evaluate the amount of food stamp benefits provided to these at-risk families but also should increase referrals to food assistance programs and decrease the barriers to participation in an effort to maximize the utilization of programs of the NNSN. The goal of increasing food security and thus reducing the mental and physical health problems associated with hunger is an impetus to further investigate and act on food insecurity issues among low-income households with children. ■

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### Contributors

Both authors participated in the conception, implementation, and evaluation of the study and in the preparation of the article.

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### Human Participant Protection

The consent form and the study design were approved by the University of Maryland human subjects institutional review board. A memorandum of agreement was signed between the University of Maryland Department of Nutrition and Food Science and the Maryland State Department of Human Resources ensuring confidentiality of food stamp receipt.

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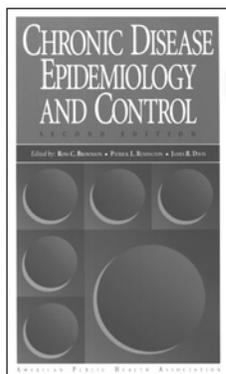
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# Use of Preventive Services by Men Enrolled in Medicare+Choice Plans

Leo S. Morales, MD, PhD, Jeannette Rogowski, PhD, Vicki A. Freedman, PhD, Steven L. Wickstrom, MS, John L. Adams, PhD, and José J. Escarce, MD, PhD

Delivery of clinical preventive services to older adults can reduce premature morbidity and mortality while preserving functioning and enhancing quality of life.<sup>1</sup> Currently, the US Preventive Services Task Force recommends annual influenza vaccinations starting at the age of 65 years and colorectal cancer (CRC) screening starting at 50 years.<sup>2,3</sup> Although not universally endorsed, annual prostate-specific antigen (PSA) testing is increasingly used by physicians to screen for prostate cancer.<sup>4</sup> Most major medical organizations recommend that physicians discuss with patients the potential benefits and harms of PSA testing and individualize the decision to screen.<sup>5</sup> The most appropriate candidates for PSA screening are men older than 50 years with a life expectancy of 10 years.

Previous studies have shown that race and socioeconomic status are important determinants of the use of preventive services by Medicare beneficiaries enrolled in traditional fee-for-service Medicare.<sup>6–12</sup> For example, one study showed that Black beneficiaries in fee-for-service Medicare were 39% less likely than White beneficiaries to receive an influenza vaccination.<sup>6</sup> Other studies have shown that low-income beneficiaries are 26% to 39% less likely than high-income beneficiaries to receive an influenza vaccination and that poor elderly men are 29% less likely than more affluent seniors to undergo prostate cancer screening.<sup>6,7</sup>

Overall, Medicare beneficiaries enrolled in HMOs are more likely than those enrolled in fee-for-service plans to undergo cancer screening or receive an influenza vaccination.<sup>8,13,14</sup> However, only a few studies have assessed socioeconomic and racial disparities in the use of preventive services in Medicare HMOs.

Schneider et al.<sup>9</sup> found disparities in breast cancer screening by race, education, and income in their study of a national sample of Medicare HMOs. Scott et al.<sup>10</sup> found that, among Medicare HMO enrollees, race/ethnicity and inadequate health literacy were indepen-

**Objectives.** We examined the effect of demographic and socioeconomic factors on use of preventive services (prostate-specific antigen testing, colorectal cancer screening, and influenza vaccination) among elderly men enrolled in 2 Medicare+Choice health plans.

**Methods.** Data were derived from administrative files and a survey of 1915 male enrollees. We used multivariate logistic regression to assess the effects of enrollee characteristics on preventive service use.

**Results.** Age, marital status, educational attainment, and household wealth were associated with receipt of one or more preventive services. However, the effects of these variables were substantially attenuated relative to earlier studies of Medicare.

**Conclusions.** Some Medicare HMOs have been successful in attenuating racial and socioeconomic disparities in the use of preventive services by older men. (*Am J Public Health.* 2004;94:796–802)

dently associated with never having received an influenza vaccination. Schneider et al.<sup>8</sup> found that White Medicare beneficiaries were substantially more likely than Blacks to receive an influenza vaccination and that there were no differences in terms of racial disparities between Medicare HMOs and traditional Medicare fee for service.

In the present study, we investigated the effects of racial and socioeconomic factors on the use of 3 preventive services (PSA testing, CRC screening, and influenza vaccination) among elderly men enrolled in 2 Medicare+Choice HMOs.

## METHODS

### Conceptual Framework

We adopted Andersen's behavioral model of health care use to guide our selection of variables for this study.<sup>15</sup> Previous researchers have applied this model to the use of preventive services in various patient populations.<sup>16,17</sup> The model posits that use of care is a function of predisposing, enabling, and need factors. Predisposing factors include characteristics such as age, gender, education, ethnicity, and health beliefs (e.g., health locus of control). Enabling factors include having a usual source of care, insurance status, income, and wealth. Finally, need factors are indicators of health

status, either as perceived by the individual or as evaluated by health care providers.

### Setting

Both of the health plans assessed here have Medicare risk contracts and participate in the Medicare+Choice program.<sup>18</sup> Both plans are based on the independent practice association model and contract with health care providers in their communities. One plan is located in a northeastern metropolitan area, and the other is located in the Midwest. Enrollees in the northeastern plan are required to select a primary care physician (PCP), whereas enrollees in the midwestern plan are not required to do so. At the time of the study, copayments for office visits were \$15 in the northeastern plan and \$10 in the midwestern plan. Other benefits were similar in the 2 plans, and each provided limited coverage for prescription drugs. Both plans participated in the national reminder program focusing on influenza vaccination, which consisted of a reminder letter to enrollees.

### Participants

The target population for our study consisted of 19 285 elderly Medicare beneficiaries (i.e., 65 years or older) enrolled in the 2 study plans. We used stratified random sampling to increase the number of low-income

enrollees in the study sample. For each study plan, one stratum consisted of enrollees who were eligible for Medicaid in addition to Medicare. The remaining enrollees in each plan were assigned to a low-income stratum if they resided in a zip code area where the majority of households had incomes less than twice the federal poverty level, according to the 1990 census, and to a high-income stratum otherwise.

We oversampled dually eligible (Medicaid and Medicare) beneficiaries and beneficiaries in the low-income strata, selecting sampling probabilities to obtain roughly equal numbers of enrollees from each plan. The resulting initial sample consisted of 6996 enrollees from the 2 plans: 942 dually eligible enrollees, 700 enrollees in low-income zip code areas, and 5354 enrollees in high-income zip code areas.

### Data Sources

Data were derived from study plan administrative files and a telephone survey of plan enrollees. The administrative data consisted of provider and facility claims for all services provided to enrollees in the study sample between January 1 and December 31, 2000. We identified services using codes from the Centers for Medicare and Medicaid Services Common Procedure Coding System (HCPCS). (HCPCS codes are similar to Current Procedural Terminology codes.<sup>19</sup>)

The survey included modules on demographic and socioeconomic characteristics, health status, family and household structure, attitudes and beliefs regarding medical care, and experience with health insurance and health care. The module focusing on demographic and socioeconomic characteristics elicited information on gender, race/ethnicity, educational attainment, household income, and household wealth (calculated, for each respondent, as the sum of current worth of real estate; checking and savings accounts; certificates of deposit, government savings bonds, and treasury bills; individual retirement accounts and Keogh plans; and stocks and mutual funds).<sup>20</sup>

Health status was assessed with the Medical Outcomes Study 12-Item Short-Form Health Survey, which yields summary measures of physical health (Physical Component Summary) and mental health (Mental Component

Summary) that range from 0 to 100, with means of 50 and standard deviations of 10 in the general population.<sup>21</sup> The module on family and household structure elicited information on marital status, number and gender of children, and number of people residing in the household.

The attitudes and beliefs module used a 3-item scale to assess respondents' perceived "health locus of control," a social learning theory construct that refers to whether health and health outcomes are under respondents' control or the control of medical care providers.<sup>22,23</sup> Each item was scored on a scale ranging from 1 to 3, with higher scores reflecting a stronger belief in the efficacy of formal medical care versus self-care. The module focusing on lifetime experience with health insurance and health care elicited information on respondents' cumulative years of insurance coverage and whether they had a usual source of medical care before Medicare.

The survey was conducted between April and October 2000. Five hundred twenty-eight enrollees in the initial study sample were ineligible because they were no longer enrolled in a study plan when they were contacted. Of the remaining 6468 enrollees, 4613 completed the survey, for a 72% response rate. The analyses described here were restricted to the 1915 male survey respondents (962 in the northeastern plan and 953 in the midwestern plan).

### Regression Models

We used multivariate regression models to assess the effects of socioeconomic and demographic factors on use of preventive services.

*Dependent variables.* The dependent variables used in the regression models were 3 binary variables indicating receipt of each preventive service during calendar year 2000. We used a claim with an HCPCS code of 84153 or 84154 to identify PSA testing and a claim with an HCPCS code of 90657, 90658, 90659, 90660, 90724, or G0008 to identify an influenza vaccination. We defined CRC screening as fecal occult blood testing (FOBT), sigmoidoscopy, colonoscopy, or double contrast barium enema (DCBE). HCPCS codes were 82270 for FOBT; 45330, 45331, 45333, 45338, or 45339 for sigmoidoscopy; 45378, 45380, 45383, 45384,

or 45385 for colonoscopy; and 74280 for DCBE. In addition, we defined a dependent variable indicating the total number of preventive services received by each enrollee (range: 0 to 3).

*Independent variables.* The independent variables in our main analyses included indicator variables for 5 age categories, 3 race/ethnicity categories, 4 marital status categories, 5 educational attainment categories, 5 categories of household income based on percentage of federal poverty level, and 5 categories of household wealth based on percentiles of the distribution of wealth across the men and women in the sample. The Physical Component Summary and Mental Component Summary scores and the scores for the attitudes and beliefs items were entered as continuous variables. All models also included an indicator variable for whether a proxy respondent was used during the interview. In addition, analyses of pooled data from both plans (as described subsequently) included an indicator variable for the northeastern plan.

In secondary analyses, we included several indicator variables (one at a time) as additional independent variables. These variables were as follows: dual Medicaid eligibility, having had a usual source of care before Medicare, having had health insurance before Medicare, having been in an HMO before Medicare, having living children, having children living at home, and living with an adult partner regardless of marital status.

*Estimation.* We conducted separate analyses for each study plan as well as analyses involving the pooled sample. We estimated regression models for receipt of each preventive service as binary logistic models, and we estimated the models for the total number of preventive services received as ordinal logistic models.<sup>24</sup> In addition to tests of statistical significance for individual independent variables, we conducted joint significance tests on sets of related indicator variables (e.g., the set of indicator variables for income categories). We weighted analyses using weights that reflected both the sample design and survey nonresponse; the Stata SVY suite of commands, which accounts for complex sampling designs, was used in conducting all analyses.<sup>25</sup> Nonresponse weights were based on cells defined according to gender, age, and

the stratification variables. A *P* value of .05 or less was considered statistically significant.

**RESULTS**

Fifty-eight percent of the men were 65 to 74 years old, whereas only 6% were 85 years old or older (Table 1). Seventy-three percent were married, and 89% were non-Hispanic Whites. Thirty-seven percent had failed to finish high school, while 31% had completed at least some college. Eleven percent had household incomes below 125% of the poverty level, and 21% had incomes above 400% of the poverty level.

Overall, 49% of the men underwent PSA testing, 32% underwent CRC screening, and 49% received an influenza vaccination. The mean number of preventive services received by the men was 1.27 (range: 0–3).

**Regression Results: Pooled Analyses**

*Prostate-specific antigen.* Age, marital status, race, and household wealth were statistically significantly associated with PSA testing according to joint tests of related variables (*P*<.05). Tests of individual variables showed that men aged 80 to 84 years and aged 85 years or older were less likely than men aged 65 to 69 years to have undergone PSA testing (Table 2), and men who had never been married were more likely than married men to have undergone testing. Men in the higher wealth categories were more likely than men in the lowest category to have undergone testing. Finally, better physical health was associated with a higher probability of receiving PSA testing.

*Colorectal cancer screening.* Only age was significantly associated with CRC screening in joint tests of related variables. Tests of individual variables showed that men aged 85 years or older were less likely than men aged 65 to 69 years to have undergone CRC screening (Table 2). In addition, men in the northeastern plan were more likely than men in the midwestern plan to have undergone screening. In secondary analyses, we failed to find any sociodemographic subgroup differences in rates of FOBT alone or in the receipt of any one of the more expensive screening tests, including sigmoidoscopy, colonoscopy, and DCBE (data not shown).

**TABLE 1—Characteristics of the Sample**

Characteristic	Unweighted No.	Weighted % (or Mean)
<b>Age, y</b>		
65–69	512	27
70–74	580	31
75–79	449	23
80–84	263	13
≥85	111	6
<b>Marital status</b>		
Married	1367	73
Widowed	292	15
Separated/divorced	180	8
Never married	76	3
<b>Race/ethnicity</b>		
Non-Hispanic White	1649	89
Non-Hispanic Black	186	7
Other	80	4
<b>Educational attainment</b>		
No high school	311	16
Some high school	390	21
High school	622	32
Some college	307	16
College	285	15
<b>Household wealth (percentile)</b>		
<0–25	335	16
≥25–<50	447	22
≥50–<75	507	27
≥75–<90	338	20
≥90–100	288	15
<b>Household income (% of poverty level)</b>		
<100	115	5
≥100–<125	134	6
≥125–<200	516	27
≥200–<400	775	42
≥400	375	21
<b>Attitudes and beliefs (mean scores)</b>		
Doctors' care not needed	...	2.29
Home remedies better	...	2.44
Recovery depends on self	...	1.32
Physical Component	...	44.50
Summary score (mean)		
Mental Component	...	54.70
Summary score (mean)		

*Note.* Scores on the attitudes and beliefs about medical care variable ranged from 3 to 9, with higher scores reflecting a stronger belief in the efficacy of formal medical care (vs self-care).

*Influenza vaccination.* According to joint tests of related variables, marital status, education, and wealth were significantly associated with receipt of influenza vaccination. Tests of individual variables showed that men who were separated or divorced were less likely than married men to have received an influenza vaccination, and men who had never married were more likely than married men to have been vaccinated (Table 2). Men with some college and college graduates were more likely than men with less than a high school education to have received the vaccination.

In addition, men in the highest wealth category were more likely than men in the lowest category to have received an influenza vaccination. A stronger belief that a doctor's care was needed when one was sick was associated with a higher probability of receiving a vaccination. Finally, men in the northeastern plan were more likely than men in the midwestern plan to have received the vaccine.

*Adjusted preventive service rates.* To assist readers in interpreting the odds ratios shown in Table 2, we present adjusted rates of preventive service use for the race/ethnicity, education, income, and wealth variables in Table 3 (unadjusted rates are also presented in Table 3 for comparison).

*Number of preventive services received.* As mentioned, the average number of preventive services received by the men was 1.27, with means of 1.38 in the northeastern plan and 1.02 in the midwestern plan (data not shown). Marital status, household wealth, and health plan (northeastern vs midwestern) were significantly associated with number of preventive services received according to joint tests of independent variables. Tests of individual variables showed that widowed men and men who were separated or divorced received fewer preventive services than married men, whereas men who had never been married received more services than married men (Table 4). Men in the highest wealth category received more preventive services than men in the lowest wealth category. Finally, men in the northeastern plan received more preventive services on average than men in the midwestern plan.

In secondary analyses, having had a usual source of care before Medicare was positively

**TABLE 2—Pooled Analyses of Preventive Service Use: Logistic Regression Results**

Characteristic	Prostate-Specific Antigen Testing		Colorectal Cancer Screening		Influenza Vaccination	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
<b>Age, y</b>						
65–69	1.00		1.00		1.00	
70–74	1.05	0.81, 1.37	1.13	0.85, 1.50	0.97	0.74, 1.28
75–79	1.07	0.79, 1.43	1.24	0.90, 1.69	1.26	0.94, 1.70
80–84	0.66	0.46, 0.94*	0.94	0.64, 1.39	1.02	0.71, 1.46
≥85	0.59	0.35, 1.00*	0.51	0.26, 0.98*	1.28	0.77, 2.13
<b>Marital status</b>						
Married	1.00		1.00		1.00	
Widowed	0.75	0.55, 1.02	0.88	0.62, 1.24	0.79	0.58, 1.08
Separated/divorced	0.75	0.51, 1.10	0.77	0.50, 1.18	0.57	0.38, 0.85**
Never married	1.79	1.02, 3.12*	1.54	0.87, 2.73	1.82	1.08, 3.08*
<b>Race/ethnicity</b>						
Non-Hispanic White	1.00		1.00		1.00	
Non-Hispanic Black	1.38	0.96, 1.98	0.76	0.47, 1.22	0.69	0.46, 1.04
Other	0.56	0.32, 0.98*	0.60	0.32, 1.13	0.68	0.39, 1.17
<b>Education</b>						
No high school	1.00	0.73, 1.48	1.00		1.00	
Some high school	1.04	0.87, 1.70	1.02	0.69, 1.49	1.36	0.95, 1.97
High school	1.21	0.74, 1.64	1.16	0.81, 1.67	1.37	0.97, 1.93
Some college	1.10	0.83, 1.87	0.91	0.59, 1.40	1.85	1.24, 2.75**
College or more	1.24	0.73, 1.48	1.04	0.67, 1.62	1.59	1.04, 2.41*
<b>Household wealth (percentile)</b>						
<0–25	1.00		1.00		1.00	
≥25–<50	1.39	0.98, 1.97	0.82	0.56, 1.20	1.08	0.76, 1.54
≥50–<75	1.81	1.27, 2.58**	0.88	0.60, 1.30	1.16	0.80, 1.66
≥75–<90	1.22	0.82, 1.81	1.05	0.69, 1.61	1.06	0.71, 1.59
≥90–100	1.67	1.06, 2.61*	1.36	0.85, 2.18	1.62	1.03, 2.54*
<b>Household income (% of poverty level)</b>						
<100	1.00		1.00		1.00	
≥100–<125	1.30	0.71, 2.40	1.43	0.71, 2.89	1.22	0.66, 2.26
≥125–<200	1.00	0.60, 1.66	1.47	0.82, 2.61	1.03	0.62, 1.69
≥200–<400	0.99	0.60, 1.64	1.52	0.85, 2.74	0.91	0.55, 1.51
≥400	1.23	0.70, 2.16	1.52	0.80, 2.87	0.81	0.46, 1.42
<b>Attitudes and beliefs</b>						
Doctors' care not needed	1.03	0.90, 1.18	1.06	0.92, 1.23	1.17	1.02, 1.34*
Home remedies better	0.96	0.82, 1.11	0.90	0.77, 1.07	1.02	0.87, 1.19
Recovery depends on self	0.96	0.81, 1.14	0.98	0.81, 1.18	1.02	0.85, 1.21
Physical Component	1.01	1.00, 1.02*	1.00	0.99, 1.02	0.99	0.98, 1.00
Summary score						
Mental Component	1.01	1.00, 1.02	1.01	0.99, 1.02	1.00	0.99, 1.02
Summary score						
<b>Health plan</b>						
Midwestern	1.00		1.00		1.00	
Northeastern	1.16	0.95, 1.41	2.05	1.64, 2.55**	2.16	1.76, 2.65**

Note. Regression analyses included controls for proxy respondents.  
\* $P < .05$ ; \*\* $P < .01$  (for test of null hypothesis that odds ratio is 1.00).

and significantly associated with probability of undergoing PSA testing and with number of preventive services received ( $P < .05$ ), but findings for socioeconomic and demographic characteristics were unaffected when we included this variable. None of the other variables examined in the secondary analyses were associated with use of preventive services.

**Regression Results: Stratified Analyses**

In stratified analyses conducted for each study plan, we found that the effects of most socioeconomic and demographic factors were similar in the 2 plans with the exception of household income, which was associated with greater PSA testing and CRC screening among men in the midwestern plan but not among men in the northeastern plan. Higher household income was also positively associated with number of preventive services received in the midwestern plan but not the northeastern plan. Data supporting these results are available from the authors on request.

**DISCUSSION**

We found a number of demographic and socioeconomic characteristics that were associated with PSA testing, CRC screening, and influenza vaccination among men enrolled in 2 Medicare+Choice plans. Age, marital status, educational attainment, and household wealth were all associated with the use of one or more of the 3 preventive services we studied. Qualitatively, these results are consistent with the literature on racial and socioeconomic disparities in the use of preventive services in traditional fee-for-service Medicare<sup>6,7,11,12,26,27</sup> and in Medicare HMOs.<sup>8–10</sup> However, the effects of socioeconomic and racial factors were substantially attenuated in our study relative to previous studies, particularly with respect to racial disparities in influenza vaccination rates.

Schneider et al.,<sup>8</sup> for example, found a 19% difference in influenza vaccination rates between Black and White Medicare beneficiaries after adjusting for age, education, income, and health status, and Carrasquillo et al.<sup>28</sup> found a 20% difference in influenza vaccination rates between Black and White Medicare beneficiaries. Scott et al.<sup>10</sup> found that Blacks were 60% more likely than

**TABLE 3—Unadjusted and Adjusted Rates of Preventive Service Use, by Race/Ethnicity and Socioeconomic Group**

Characteristic	Prostate-Specific Antigen Testing		Colorectal Cancer Screening		Influenza Vaccination	
	Unadjusted %	Adjusted % <sup>a</sup>	Unadjusted %	Adjusted % <sup>a</sup>	Unadjusted %	Adjusted % <sup>a</sup>
<b>Race/ethnicity</b>						
Non-Hispanic White <sup>b</sup>	50	49	35	31	46	42
Non-Hispanic Black	50	56	19**	26	26**	34
Other	35*	35*	24	21	36	34
<b>Educational attainment</b>						
No high school <sup>b</sup>	41	46	29	29	36	34
Some high school	47	47	32	29	44	41
High school	51*	50	35	32	44*	41
Some college	50**	48	31	27	51**	48**
College	57**	51	37	30	49**	44**
<b>Household wealth (percentile)</b>						
<0-25 <sup>b</sup>	38	41	31	30	39	38
≥25-<50	47*	48	27	26	40	40
≥50-<75	55**	55**	32	28	46	41
≥75-<90	48*	45	37	31	45	39
≥90-100	58**	53*	42*	37	53**	49*
<b>Household income (% of poverty level)</b>						
<100 <sup>b</sup>	42	47	23	23	38	43
≥100-<125	48	54	29	29	44	47
≥125-<200	44	47	31	30	44	43
≥200-<400	50	47	34*	31	45	40
≥400	57*	52	37*	31	47	38

<sup>a</sup>Adjusted for age, marital status, race/ethnicity, education, wealth, income, attitudes, Physical Component Summary and Mental Component Summary scores, health plan, and proxy respondent.

<sup>b</sup>Reference category for statistical tests of differences in rates.

\**P* < .05; \*\**P* < .01 (for test of null hypothesis that rate is equal to rate in reference category).

**TABLE 4—Pooled Analyses of Number of Preventive Services Used: Ordinal Logistic Regression Results**

	Odds Ratio	95% Confidence Interval
<b>Age, y</b>		
65-69	1.00	
70-74	1.06	0.83, 1.36
75-79	1.26	0.96, 1.65
80-84	0.81	0.59, 1.11
≥85	0.72	0.50, 1.05
<b>Marital status</b>		
Married	1.00	
Widowed	0.74	0.57, 0.97*
Separated/divorced	0.61	0.43, 0.87**
Never married	2.03	1.27, 3.24**
<b>Race/ethnicity</b>		
Non-Hispanic White	1.00	
Non-Hispanic Black	0.91	0.64, 1.29
Other	0.52	0.32, 0.85**
<b>Education</b>		
No high school	1.00	
Some high school	1.15	0.82, 1.61
High school	1.34	0.98, 1.84
Some college	1.38	0.96, 1.98
College or more	1.39	0.94, 2.05
<b>Household wealth (percentiles)</b>		
<0-25	1.00	
≥26-<50	1.07	0.79, 1.47
≥51-<75	1.31	0.96, 1.79
≥76-<90	1.15	0.80, 1.66
≥91-100	1.78	1.20, 2.64**
<b>Household income (% of poverty level)</b>		
<100	1.00	
≥100-≤125	1.44	0.80, 2.60
≥125-≤200	1.20	0.75, 1.92
≥200-≤400	1.16	0.72, 1.86
≥400	1.19	0.70, 2.01
<b>Attitudes and beliefs</b>		
Doctors' care not needed	1.11	0.98, 1.25
Home remedies better	0.95	0.83, 1.09
Recovery depends on self	0.99	0.85, 1.15
Physical Component Summary score	1.01	1.00, 1.01
Mental Component Summary score	1.01	1.00, 1.02
<b>Health plan</b>		
Midwestern	1.00	
Northeastern	1.96	1.65, 2.34**

Note. Regression analyses included controls for proxy respondents.

\**P* < .05; \*\**P* < .01 (for test of null hypothesis that odds ratio is 1.00).

Whites to report never having had an influenza vaccination. By contrast, we did not find a racial disparity in influenza vaccination rates after adjusting for confounding variables. It is important to note that our results may differ from those of previous studies (1) because we used administrative data to measure preventive service use, whereas many other studies have relied on patient self-reports, and (2) because the rates we report for influenza vaccination and CRC screening were based only on men.

On the other hand, we did find disparities according to educational attainment and wealth. Specifically, we found a 14% difference in influenza vaccination rates between men with less than a high school education and men with some college and a 10% differ-

ence between men with less than a high school education and men who were college graduates. We also found an 11% difference in influenza vaccination rates between men in the lowest and highest wealth categories. These results are consistent with those of previous studies. In particular, Schoen et al.<sup>7</sup> found that Medicare beneficiaries at higher income levels were 15% more likely than beneficiaries at lower income levels to receive an influenza vaccination. Scott et al.<sup>10</sup> found that Medicare beneficiaries at inadequate levels of health literacy were 40% more likely than those with adequate health literacy to report never having had an influenza vaccination. Schneider et al.<sup>8</sup> found that Medicare beneficiaries who had not completed high school were 10% less likely than those who

had completed high school or college to receive an influenza vaccination.

We found no significant disparities in CRC screening rates according to race, income, wealth, or educational attainment after adjusting for confounding variables. These findings are consistent with those of previous research on disparities with respect to race but not with respect to income or education. For example, Breen et al.<sup>27</sup> reported a 7% difference in CRC screening between Blacks and Whites, and a 6% difference was reported in *Healthy People 2010*.<sup>29</sup> However, a 15% difference in FOBT rates according to educational attainment and a 16% difference according to income level were also reported in *Healthy People 2010*.<sup>29</sup> In contrast, we found no statistically significant disparities in CRC screening according to educational attainment or income level after adjusting for confounding variables.

Relatively few studies have examined disparities in prostate cancer screening rates. Overall, we found few differences in PSA screening rates according to race, education, income, or wealth in the 2 HMOs we studied. We were reassured by our finding that PSA testing diminished among men 80 years or older relative to men in younger age groups, as one would expect on the basis of screening recommendations that only men with a 10-year life expectancy be screened.

Our findings raise the possibility that requiring plan enrollees to select a PCP may attenuate socioeconomic disparities in use of preventive services. Our plan-specific analyses revealed income-related differences in PSA testing, CRC screening, and number of preventive services used in the midwestern plan, which does not require enrollees to choose a PCP, but not in the northeastern plan, which does include this requirement. Mandatory enrollment with a PCP may foster regular patient-provider relationships, which in turn may promote use of preventive services, especially among low-income people.<sup>30</sup> Williams et al.<sup>31</sup> found that Black patients who are able to access primary care receive preventive services at rates similar to those observed among White patients. Our finding regarding differences between the study plans in regard to the effects of income must be regarded cautiously, however, because we included only

one HMO of each type in our study; additional research should include more plans of multiple types.

Notably, the 2 Medicare HMOs we studied had low overall rates of preventive service delivery in comparison with national benchmarks. Overall, 32% of enrolled men underwent CRC screening, 49% received an influenza vaccination, and 49% underwent PSA testing. By comparison, a Medicare report<sup>32</sup> indicated that 66% of beneficiaries received influenza vaccinations in 1998, the Centers for Disease Control and Prevention<sup>33</sup> reported that 53% of adults older than 50 years underwent CRC screening by either FOBT or lower endoscopy in 2001, and Love et al.<sup>34</sup> found that 67% of men 50 years or older seen in urban primary care practices had undergone PSA testing. Low screening rates, however, should not have biased our results in regard to disparities within the plans assessed here.

Our study involved several limitations. First, we constructed a measure of CRC screening using only 1 year of data by combining screening modalities whose recommended intervals varied. Current guidelines recommend annual FOBT, annual FOBT in conjunction with sigmoidoscopy every 5 years, sigmoidoscopy alone every 5 years, DCBE every 5 years, or colonoscopy every 10 years.<sup>35</sup> Because sigmoidoscopy alone, DCBE, or colonoscopy may substitute for FOBT for the duration of the screening interval, our use of 1 year of data may have resulted in underestimates of the true CRC screening rate. Some people who did not undergo FOBT or any other screening test in a given year may have been in compliance with screening guidelines but were classified as unscreened.

We may have also underestimated screening rates as a result of incomplete recording of these services in claims data, especially in regard to influenza vaccination. There is no published research assessing the use of claims data to identify influenza vaccinations, in contrast to studies showing excellent sensitivity and specificity of claims data for ascertaining CRC screening<sup>36</sup> and PSA testing.<sup>11</sup>

Second, because we used administrative data to identify preventive service use, we were unable to distinguish between tests or

procedures performed for screening and those performed for monitoring disease progression, diagnosis, or treatment. However, some of these concerns are obviated because we were investigating subgroup differences defined by factors not known to influence the underlying pathology of colorectal or prostate cancer. Finally, we cannot exclude the possibility that our findings were attributable to unobserved characteristics of the Medicare beneficiaries who chose to enroll in the study plans rather than attributable to features of the plans themselves.

Our study suggests that some Medicare+Choice HMOs have been effective in reducing socioeconomic and racial disparities in use of preventive services endemic to Medicare. This finding stands apart from the many shortcomings of Medicare managed care recently noted, including reductions in the benefits offered by Medicare managed care plans and increased inequities in the benefits offered by plans in various areas of the country.<sup>37</sup> Additional research is needed to provide a better understanding of the effects of PCPs on disparities in preventive service use, identify other plan features that may attenuate disparities, and assess the extent to which the findings described here are generalizable to other Medicare HMOs. ■

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#### Contributors

L. S. Morales and J. J. Escarce led the analysis for this study, with assistance from S. L. Wickstrom and J. L. Adams. L. S. Morales led the writing of the article. J. Rogowski, V. A. Freedman, and J. J. Escarce conceived the study and supervised all aspects of its implementation. All of the authors helped conceptualize ideas and interpret findings and reviewed drafts of the article.

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The RAND institutional review board reviewed all procedures, forms, and materials used in this study. Study participants provided informed consent.

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# Effect of Discrimination on Mental Health Service Utilization Among Chinese Americans

Michael S. Spencer, PhD, MSSW, and Juan Chen, MSW

Low utilization of mental health services by Asian Americans/Pacific Islanders is well documented.<sup>1-7</sup> Nationally, Asian American/Pacific Islander populations are 3 times less likely than White populations to use available mental health services.<sup>8</sup> Data from the Chinese American Epidemiology Study (CAPES) indicated that only 17% of Chinese Americans who experienced problems with emotions, anxiety, drugs, alcohol, or mental health in the past 6 months sought care.<sup>9</sup> Less than 6% of these patients saw mental health professionals, 4% saw medical doctors, and 8% saw a minister or priest.

Barriers to service utilization are often conceptualized as issues of availability and access. The supplement to the surgeon general's report on mental health states that nearly half of the Asian American/Pacific Islander population's low utilization of mental health services is attributable to lack of English proficiency and a shortage of providers who possess appropriate language skills.<sup>10</sup> Accessibility of mental health services to Asian Americans/Pacific Islanders has been found to be associated with health insurance coverage—21% of all Asian Americans/Pacific Islanders lack health insurance. Twenty percent of Chinese Americans lack health insurance, and only 13% of Chinese Americans with family incomes below 200% of the federal poverty level have Medicaid coverage (compared with 24% of Whites in the same income bracket).<sup>10,11</sup>

Family and extended family serve as an active support system and a source of help for psychological problems. The family unit and the extended family serve an important function in taking collective responsibility to care for an emotionally impaired member.<sup>13</sup> When a family is unable to resolve the problem, it may turn to outside help within the ethnic community, consulting indigenous healers, community elders, and physicians for assistance.<sup>12,13</sup> Although these support systems are

**Objectives.** We examined the association between discrimination and mental health service use among a representative sample of Chinese Americans.

**Methods.** Our data were derived from the 2-wave Chinese American Psychiatric Epidemiological Survey, a strata-cluster survey conducted in 1993 and 1994 in a western American city.

**Results.** Language-based discrimination was associated with higher levels of use of informal services and seeking help from friends and relatives for emotional problems. Negative attitudes toward professional mental health services were associated with greater use of informal services.

**Conclusions.** The findings suggest that language-based discrimination influences patterns of mental health service use among Chinese Americans. Implications for service providers and policymakers are discussed. (*Am J Public Health*. 2004;94:809-814)

certain to play an important role in maintaining Asian American/Pacific Islanders' well-being, use of such informal support systems may result in delay in seeking professional treatment until symptoms become severe and unmanageable. Studies of community mental health centers, county mental health systems, and student psychiatric clinics have found that Asian Americans/Pacific Islanders who use mental health services tend to be more severely ill than Whites who use the same services.<sup>7,14-17</sup>

Cultural and social contexts shape the mental health of ethnic minorities and influence the types of mental health services they use; racism and discrimination are facets of the social context that are ever present in the lives of racial/ethnic minorities.<sup>10,18-24</sup> History is fraught with examples of policies and practices that have systematically discriminated against Asian Americans/Pacific Islanders (e.g., the Chinese Exclusion Act of 1882, the Immigration Act of 1917, the Tydings-McDuffie Act of 1934, Executive Order 90666 in 1942). Past abuses and the perceived mistreatment of racial and ethnic minorities by medical and mental health professionals may precipitate mistrust of service providers. Although mistrust has been hypothesized to represent a major barrier to the receipt of mental health treatment by racial/ethnic minorities, very lit-

tle empirical evidence is available to document.<sup>10</sup> Studies that have examined the relation between discrimination and mental health service use have found that higher proportions of African Americans and Latinos than of Whites felt that a doctor or health provider had judged them unfairly or treated them with disrespect because of their race or ethnic background. Clinician bias and stereotyping also play a role in mistrust and subsequent service utilization in minorities.<sup>25-27</sup> Takeuchi, Mokuau, and Chun noted that one of the difficulties of establishing culturally responsive mental health services for Asian Americans/Pacific Islanders is a lack of congruence between the characteristics of the mental health system and the characteristics of the minority group culture; assessment instruments, agency policies, clinicians, and practices do not address the concerns or take into account the special needs of minority clients.<sup>28</sup> Uba identified the following barriers to mental health service utilization for Asian Americans/Pacific Islanders: (1) racial and cultural biases (culturally inappropriate services, differential receipt of services compared with Whites, a history of institutional discrimination and insensitivity, a feeling of being unwelcome, and suspicion of the service delivery system); (2) conflicts between the epistemological underpinnings and characteristics of "Western" psychotherapy

and the personality syndromes, values, expectations, and interpersonal styles of Asian Americans/Pacific Islanders; (3) Asian/Pacific Islander cultural attitudes toward seeking help and perceptions of the usefulness of such help; (4) language barriers; (5) a shortage of bilingual and culturally sensitive service providers; and (6) lack of knowledge of existing services.<sup>29</sup> Thus, although evidence for an association between discrimination and mental health service use is scant, there is general agreement in the literature that such discrimination is an area of concern and requires further research.

The purpose of this study was to examine the association between discrimination and mental health service utilization; we controlled for demographic characteristics, socioeconomic status, psychological stress, immigration status, and traditional barriers to services related to access and attitudes. In addition to formal and informal mental health services, seeking help from friends and relatives was also included as a mental health service outcome. It was hypothesized that discrimination would be associated with less use of formal services, greater use of informal services, and increased incidences of seeking help from friends and relatives.

## METHODS

### Sample

The data for this study were taken from the 2-wave CAPES. The CAPES is the largest psychiatric epidemiological study of an Asian American/Pacific Islander group to have obtained *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition*,<sup>30</sup> diagnoses for all participants. The CAPES is a strata-cluster survey conducted in 1993–1994 in the greater Los Angeles area. The survey's probability sample of 1747 Chinese American households is representative of the general Chinese American population residing in the area. We designed the 3-stage sampling procedure to (1) select tracts from the 1652 census tracts in Los Angeles County, which were cross-stratified by the percentage of Chinese American households in census tracts, the median income for Asian American/Pacific Islander households in tracts, and the racial/ethnic percentage in the tracts; (2) ran-

domly select 12 blocks within each of the tracts; and (3) randomly select 4 households within each of the blocks. Selection in the first 2 stages was designed with probabilities proportional to size, such that even though selection probabilities varied within each stage, the ultimate selection probabilities were the same for all Chinese households (see Takeuchi et al.<sup>31</sup> for details).

The sample for the current study consisted of 1503 adults interviewed in both waves of the survey. Combining the 2 waves allowed us to maximize the incidence of lifetime psychiatric disorder and mental health service use among the sample. Wave 2 measured discrimination, whereas wave 1 measured lifetime incidence of psychiatric disorders and service use. A total of 244 respondents who were interviewed in only 1 wave were excluded from the sample. However, no significant differences in the demographic characteristics examined in the study were found between the 244 respondents excluded and the 1503 respondents that composed the final sample.

### Procedures

Bilingual interviewers, fluent in English and in Mandarin or Cantonese, were recruited for this study. Whenever possible, interviewers were recruited from areas close to the sampled census tract; this close proximity helped ensure familiarity with the neighborhoods. The interviewers were lay interviewers with at least some college education.

The interviews were conducted in English, Mandarin, or Cantonese, depending on the respondent's language preference, and lasted approximately 90 minutes. Eligible individuals included Chinese Americans aged 18 to 65 years in 1993 who resided in Los Angeles County. One eligible person within each eligible household was randomly selected for the interview.<sup>32</sup> Of the eligible respondents, 1747 interviews were completed in the first wave, which resulted in an 82% response rate. In the second wave, 1503 interviews were completed out of the 1747 respondents in the first wave.

### Measures

**Psychiatric disorder.** The major diagnostic instrument used in the CAPES was the University of Michigan version of the Composite International Diagnostic Interview.<sup>31</sup> The

Composite International Diagnostic Interview is a structured interview schedule based primarily on the National Institute of Mental Health Diagnostic Interview Schedule and designed to be used by trained interviewers who are nonclinicians. Computer algorithms are used to construct clinical diagnoses based on the responses to the Composite International Diagnostic Interview. The CAPES focuses on major psychiatric disorders, including affective disorders, anxiety disorders, and alcohol and drug abuse or dependence. In the current study, we limited our analyses to affective disorders and anxiety disorders. The psychiatric disorder variable was generated by combining both lifetime and 12-month rates (any disorder) of agoraphobia, major depressive episode, dysthymia, generalized anxiety disorder, panic disorder, simple phobia, and social phobia from both waves of the CAPES. A dummy variable was computed to indicate presence of any of these lifetime disorders.

**Mental health service utilization.** Three dummy variables were computed to measure the dependent variables in our analyses: use of formal services, use of informal services, and seeking help from friends or relatives. Use of formal mental health services was assessed with a dummy variable for which 1 indicated ever having sought help for problems with emotions, nerves, drugs, alcohol, or mental health by going to "a psychiatrist or other mental health specialist at a health or family clinic"; "a psychiatrist, psychologist, social worker, or counselor in private practice"; "a medical doctor in private practice (except for a psychiatrist) or any medical person at a health plan or a primary care clinic"; "a mental health center"; "a psychiatric outpatient clinic at a general hospital or university hospital"; "an outpatient clinic in a psychiatric hospital"; "an outpatient clinic in a Veterans Administration hospital"; "a hospital emergency room"; "a family service, child counseling, or social service agency"; "someone at a self-help group like Alcoholics Anonymous"; or "[by going to] a community program like a crisis center or [by calling] a hotline number." Use of informal services was assessed with a dummy variable for which 1 indicated ever having gone to either "a minister or a priest—including a priest in a Taoist or Buddhist temple" or "a spiritualist, herbalist, or fortune-teller." Seeking help from friends or

relatives was assessed with a dummy variable in which 1 indicated ever having gone to a friend or relative for help. Use of formal services, use of informal services, and seeking help from friends or relatives are not mutually exclusive; thus, separate logit models were analyzed for each dependent variable.

**Discrimination.** We used 2 dummy variables to assess discrimination. The first variable measured race discrimination, with 1 indicating having ever been treated unfairly or badly because of one's race or ethnicity. The second variable assessed language discrimination, with 1 indicating having ever been treated unfairly or badly because "you speak a different language or you speak with an accent." Discrimination was measured only in the second wave of the CAPES.

**Demographics and socioeconomic status.** We assigned age (in years), gender (1=female), and marital status (reference group=married) as sociodemographic control variables in the analyses. Education and income were the measures of socioeconomic status. Education was divided into 3 categories: grades 0 through 11, high school, and some college and above. Income was measured as total household income during the previous year. Income was divided into 4 categories based on the percentage distribution of the sample. Household size (the number of persons living in the household) was included in all analyses that involved income, because the meaning of a given level of income is related to the number of persons living in the household.

**Stress.** Two general indicators of stress were used: negative life events and daily hassles. The life-events measure was a dummy variable, with 1 indicating any lifetime experience with items from an inventory of 10 traumatic events (combat experience; life-threatening accident; involvement in a natural disaster; witnessing someone being badly injured or killed; being raped; being sexually molested; being physically attacked or assaulted; being physically abused as a child; being neglected as a child; and being threatened with a weapon) or any experience in the past 12 months with items from an inventory of 10 negative experiences (a close friendship breakup; a long separation from a loved one; being robbed or burglarized; having a driver's license suspended; suing somebody; being sued by somebody;

having serious trouble with the police or the law; having serious ongoing tension conflicts or arguments with close relatives; having any close friends or close relatives die; having friends or relatives have a major life crisis) reported in either wave. Daily hassles measure chronic stress. Our scale captured the intensity of the following experiences (from a list of 16 items) in day-to-day life: difficulties with friends; not enough time for family; problems with children; problems with aging parents; not seeing enough people; friends or relatives too far away; social obligations; and concerns about accidents, auto maintenance, physical conditions of the neighborhood, traffic, prejudice and discrimination from others, news events, noise, crime, or pollution.

**Immigration status.** Immigration status was assessed with 2 variables: age at immigration and length of time in the United States. We recoded the age at immigration and length of time in the US from continuous variables to categorical variables with 3 values to avoid the possible misspecification of a linear relation between these variables and the log-odds ratios of the dependent variables in our logit models.

**Barriers to service utilization.** Three variables were computed to measure barriers to service utilization: attitudes, accessibility, and medical insurance status. Attitudes were assessed by calculating the mean score of 3 items: "Treatment for problems with emotions, nerves, drugs, alcohol, or mental health does not help"; "These problems will get better by themselves"; and "When seeking help in these problems, one should be concerned about what others might think." The higher the score, the more negative the attitudes toward services. Accessibility was assessed by using the mean score of 3 accessibility measures: "Treatment of problems with emotions, nerves, drugs, alcohol, or mental health takes too much time"; "It is too expensive to seek treatment for these problems"; and "I do not know where to seek help for these problems." The higher the score, the more difficult the accessibility. Although typically defined as an issue of access, having medical insurance was assessed separately (with a dummy variable, 1 indicating having medical insurance) because of previous studies that have shown medical insurance to be a significant indicator of service use.

## Analyses

We applied weights to the sample data to adjust for demographic variables, nonresponse rates, and differential probability of selection within the household. Both weighted and unweighted descriptive statistics are included in Table 1. In subsequent analyses, only weighted data were used. To test our hypothesis that discrimination is associated with mental health service use, we used binomial logit regressions to examine the association between 3 types of service use (use of formal services, use of informal services, and help seeking from friends or relatives) and discrimination. We included lifetime incidence of psychiatric disorder, demographic characteristics, socioeconomic status, stress indicators, immigration status, and barriers to service use in our logistic regression models. The weighted maximum likelihood method was used to estimate the parameters and standard errors from which Wald F statistics, probability levels, and odds ratios were calculated. We assessed statistical significance as a *P* level of .05.

## RESULTS

Table 1 shows the descriptive statistics for the sample. Among 1503 respondents, 20.5% had ever experienced an episode of at least 1 of the major psychiatric disorders investigated. Rates were 9.5% for ever having used a formal service agency, 11.3% for ever having used informal services, and 24.2% for ever having sought help from friends and relatives. About 18% of the respondents reported having been treated badly or unfairly because of their racial/ethnic status and 13% reported such treatment because they speak a different language or speak with an accent.

Table 2 presents results of the logit model for service utilization. Lifetime incidence of a psychiatric disorder showed strong and consistent associations with all of the following: use of formal services, use of informal services, and help seeking from friends or relatives. Not surprisingly, the association between having a psychiatric disorder and use of formal services was the strongest. Individuals who had ever experienced a psychiatric disorder were 3.2 times more likely to have used formal mental health services than were individuals who had never experienced a psy-

**TABLE 1—Characteristics (Unweighted and Weighted) of Chinese Americans: Chinese American Psychiatric Epidemiological Survey, 1993–1994**

	Mean (SD)		No. (%)	
	Unweighted	Weighted	Unweighted	Weighted
Psychiatric disorder			308 (20.5)	308.0 (20.5)
Service use				
Formal service use			143 (9.5)	123.2 (8.2)
Informal service use			170 (11.3)	135.7 (9.0)
Friends and relatives			364 (24.2)	329.8 (21.9)
Discrimination				
Race discrimination			269 (17.9)	251.8 (16.8)
Language discrimination			195 (13.0)	178.7 (11.9)
Age, y	40.1 (11.8)	39.6 (12.6)		
Female			788 (52.4)	745.2 (49.6)
Marital status				
Single			359 (23.9)	408.8 (27.2)
SDW			113 (7.5)	79.6 (5.3)
Married <sup>a</sup>			1028 (68.5)	1011.2 (67.4)
Education				
Grades 0–8			288 (19.2)	326.2 (21.7)
High school or GED			277 (18.5)	297.5 (19.8)
Some college <sup>a</sup>			936 (62.3)	877.9 (58.5)
Household income, \$				
0–12 499			217 (14.4)	204.6 (13.6)
12 500–24 999			416 (27.7)	469.0 (31.2)
25 000–49 999			443 (29.5)	460.1 (30.6)
≥ 50 000 <sup>a</sup>			427 (28.4)	369.2 (24.6)
Household size, no. persons	2.8 (1.5)	2.8 (1.6)		
Stress indicators				
Life events			1044 (69.5)	990.3 (65.9)
Daily hassles	1.1 (0.5)	1.1 (0.5)		
Age at immigration, y	26.1 (13.3)	26.3 (14.1)		
0–20 <sup>a</sup>			476 (31.7)	524.1 (34.9)
21–40			815 (54.3)	736.2 (49.0)
41–65			211 (14.1)	241.8 (16.1)
Length in US, y	13.7 (9.3)	13.0 (8.9)		
≤ 5			214 (14.3)	231.5 (15.4)
> 5–≤ 10			347 (23.1)	374.3 (24.9)
> 10			941 (62.6)	896.5 (59.7)
Barriers				
Attitudes	1.7 (0.6)	1.7 (0.6)		
Access	2.7 (0.8)	2.8 (0.8)		
Medical insurance			1041 (69.3)	983.6 (65.5)

Note. SDW = separated, divorced, widowed; GED = Graduate Equivalency Diploma.  
<sup>a</sup>Reference group.

Among the demographic and socioeconomic status variables examined, gender was found to be associated with use of informal services and help seeking from friends or relatives. Compared with men, women were 1.52 times more likely to use an informal service and 1.83 times more likely to seek help from friends or relatives. No significant difference existed between women and men in seeking formal service. Age was associated with help seeking from friends or relatives; the older the respondents, the less likely they were to seek help from friends or relatives. Single individuals were less likely to use informal services compared with their married counterparts. People with less education were less likely to seek help from friends or relatives. Although there is a weak association between income and service use, this association was complex and may have been confounded by the correlation among income, ever having had a psychiatric disorder, and having medical insurance.

Among stress variables, life events were associated with all of the following: use of formal services, use of informal services, and help seeking from friends or relatives. Daily hassles were associated only with help seeking from friends or relatives. Among the variables measuring immigration status, length of time in the United States was associated with use of formal services; respondents who had lived in the United States for more than 10 years were more likely to use formal services.

With regard to accessibility and attitudinal barriers, attitudes were associated with use of informal services. The more negative the attitudes held toward formal mental health services, the more likely respondents were to use informal services. Accessibility was negatively associated with use of formal services and help seeking from friends or relatives. The more difficult it was to access formal services, the less likely individuals were to use those services or to seek help from friends and relatives. Having medical insurance was associated with use of formal services and with help seeking from friends or relatives. Individuals with medical insurance were more likely to use formal mental health services, whereas people without medical insurance were more likely to seek help from friends or relatives.

chiatric disorder. Having experienced unfair or bad treatment because of one's race/ethnicity was not related to service use; however, respondents who reported experiencing unfair or bad treatment because they speak a

different language or speak with an accent were 2.2 times more likely to use informal services and 2.4 times more likely to seek help from friends or relatives relative to respondents who did not report such treatment.

**TABLE 2—Logistic Regression Models of Mental Health Service Utilization Among Chinese Americans: Chinese American Psychiatric Epidemiological Survey, 1993–1994**

	Coefficient (Odds Ratio)		
	Formal Services	Informal Services	Friends or Relatives
Psychiatric disorder	1.16† (3.18)	0.64*** (1.91)	0.56*** (1.76)
Discrimination			
Race discrimination	-0.34 (0.71)	0.18 (1.20)	-0.45* (0.64)
Language discrimination	0.42 (1.52)	0.79** (2.20)	0.89† (2.42)
Age, y	-0.01 (0.99)	-0.02 (0.98)	-0.03*** (0.97)
Female gender	0.09 (1.10)	0.42** (1.52)	0.61† (1.83)
Marital status			
Single	-0.17 (0.84)	-0.75** (0.47)	-0.42 (0.66)
SDW	0.38 (1.46)	0.39 (1.48)	0.35 (1.41)
Married <sup>a</sup>			
Education			
Grades 0–8	0.19 (1.21)	-0.41 (0.66)	-0.90† (0.41)
High school or GED	0.41 (1.50)	-0.14 (0.87)	-0.34* (0.71)
Some college <sup>a</sup>			
Household income, \$			
0–12 499	0.52 (1.68)	-0.31 (0.73)	0.01 (1.01)
12 500–24 999	0.17 (1.19)	-0.62** (0.54)	-0.15 (0.86)
25 000–49 999	0.11 (1.12)	-0.07 (0.94)	0.17 (1.19)
≥ 50 000 <sup>a</sup>			
Household size, no. persons	-0.06 (0.94)	-0.12 (0.89)	-0.04 (0.96)
Stress indicators			
Life events	0.60** (1.83)	0.67*** (1.95)	0.42*** (1.52)
Daily hassles	0.27 (1.31)	0.29 (1.34)	0.46*** (1.58)
Age at immigration, y			
0–20 <sup>a</sup>			
21–40	-0.06 (0.94)	0.45 (1.57)	-0.24 (0.79)
41–56	0.20 (1.22)	0.12 (1.13)	-0.36 (0.70)
Length in US, y			
≤ 5	-0.64* (0.52)	0.06 (1.06)	0.06 (1.06)
> 5–≤ 10	-0.64** (0.53)	-0.31 (0.73)	-0.05 (0.95)
> 10 <sup>a</sup>			
Barriers			
Attitudes	0.19 (1.21)	0.52† (1.68)	0.10 (1.10)
Access	-0.36*** (0.70)	-0.20 (0.82)	-0.40† (0.67)
Medical insurance	0.54** (1.71)	0.10 (1.10)	-0.36** (0.70)
Constant	-2.93	-2.61	0.23

Note. SDW = separated, divorced, widowed; GED = Graduate Equivalency Diploma.

\* $P \leq .10$ ; \*\* $P \leq .05$ ; \*\*\* $P \leq .01$ ; † $P \leq .001$ .

<sup>a</sup>Reference group.

with service use, discrimination resulting from speaking a different language and having an accent was an important stressor that can influence the types of services individuals may use. These findings support bilingual and bicultural services as a means for providing culturally sensitive services to Chinese Americans who may have experienced discrimination resulting from lack of English-language proficiency.

Our findings also underscore the differential effects of barriers on use of formal services, use of informal services, and seeking help from friends or relatives. Negative attitudes toward formal services are associated with greater use of informal services. To help counteract these attitudes, formal service agencies could establish collaborative partnerships with informal service providers in the area and refer clients to them when necessary. Efforts to combine traditional healing methods with evidence-based practices should also be examined. To date, almost no research has been done on empirically supported interventions for Chinese Americans. Providers of formal services can also capitalize on the common practice of seeking help from friends and relatives by encouraging and supporting positive social networks through new and existing community-based support groups. Such groups might be developed around specific interest areas, such as cooking, gardening, walking, or games.

Our findings also show that individuals with medical insurance are more likely to seek formal services, whereas individuals without medical insurance are more likely to seek help from friends or relatives. In addition to health care reform making mental health services readily available to all individuals, more multilingual education is needed regarding the availability of Medicaid; increased funding also is needed for community-based agencies that serve new immigrant populations and the uninsured.

The limitations of this study must be noted. First, the instrument used to measure perceived discrimination did not assess discrimination in multiple other areas of life or gather information on the frequency of exposure over the life course. Development of measures of discrimination is in its infancy, and continued research in this area is needed (see Krieger<sup>33</sup> for discussion). Although we used longitudinal

and with help seeking from friends or relatives, but not with use of formal services. The study hypothesis that language-based and racial/ethnic discrimination are associated with patterns of service utilization were only partially supported. Although racial/ethnic discrimination was not significantly associated

**DISCUSSION**

This study investigated the association between discrimination and mental health service utilization among Chinese Americans. Our findings suggest that discrimination is associated with greater use of informal services

data, because we combined prevalence rates across 2 waves in computing our study variables, we could not identify causal relations between the independent variables and our dependent variables. For example, individuals may have possessed negative attitudes toward service use before the study because of negative past experiences with formal services. By combining the 2-wave data, we cannot establish temporal ordering and thus cannot attribute a causal relationship between our study variables. Second, although the CAPES study focuses exclusively on Chinese Americans, more diversity exists within this ethnic category than has been examined in our analyses. For example, Chinese Americans who immigrate to the United States may have come from different sociopolitical environments—such as mainland China, Taiwan, Hong Kong, and Southeast Asian countries—and therefore may show differences in patterns of service utilization. Further research should investigate in more depth the heterogeneity of Chinese Americans and should pay more attention to how stress, acculturation, and accessibility or attitudinal barriers combine with other factors in additive or interactive ways to affect Chinese American individuals' mental health status and service utilization. ■

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### Contributors

M.S. Spencer conceived the study and supervised all aspects of its implementation. J. Chen assisted with the study, conducted the analyses, and contributed to writing the article. Both authors assisted in conceptualizing ideas, interpreting findings, and reviewing drafts of the article.

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### Human Participant Protection

No protocol approval was needed for this study.

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# Factors Associated With Colorectal Cancer Screening Among the US Urban Japanese Population

Keiko Honda, PhD, MPH

How should disease prevention strategies be organized in a heterogeneous society in which disease incidence rates vary among different groups? How are factors associated with screening among specific ethnic groups in the United States different from those among the broader population identified in the literature? In this article, I examine these questions with respect to colorectal cancer (CRC) and CRC screening among Japanese Americans.

The incidence of CRC among Japanese Americans exceeds the rate among non-Hispanic Whites<sup>1</sup>; US Japanese men rank after only Alaska Native men in terms of age-adjusted race- and gender-specific CRC incidence rates, and US Japanese women rank third, after Alaska Native and African American women.<sup>2</sup> CRC rates have also increased in Japan, which now has an incidence equivalent to that of the United States.<sup>3,4</sup>

Several epidemiological studies suggest that the higher genetic predisposition to CRC among the US Japanese population—through, for example, the fast acetylator genotype coupled with Western dietary patterns, including a diet high in red meat—may explain in part the increased CRC incidence rates in Japanese immigrants and their descendants.<sup>5,6</sup> There is growing evidence linking other factors such as socioeconomic status (SES) and screening access to the differing rates of CRC among multiethnic US populations,<sup>7–9</sup> but the mechanism by which different factors interact to increase risk is unknown.

Stage at diagnosis is one of the most important prognostic factors for CRC survival; administering appropriate screening tests is important for improved cancer outcomes.<sup>1</sup> Despite the elevated CRC incidence among Japanese Americans, no published information is available regarding CRC screening behavior in this group, which now represents 0.3% of the US population.<sup>10</sup> Results gathered from the 1997 Behavioral Risk Factor

**Objectives.** The author examined the prevalence and predictors of colorectal cancer screening among the urban Japanese population of the United States.

**Methods.** A sample of Japanese residents of major US metropolitan areas completed a self-administered mailed survey.

**Results.** Physician recommendation, acculturation, and perceived psychological costs were consistent predictors of screening for colorectal cancer. Gender and marital status were related to screening via fecal occult blood testing; age, susceptibility, and health insurance were related to sigmoidoscopy/colonoscopy screening.

**Conclusions.** Colorectal cancer screening among the urban Japanese population could be increased with interventions seeking to promote physician recommendations for screening, alleviate perceived psychological costs among patients, and improve physician–patient communication. (*Am J Public Health.* 2004;94:815–822)

Surveillance System (BRFSS)<sup>11</sup> questionnaire indicated that Asian American/Pacific Islanders (AAPIs) 50 years and older were half as likely as non-Hispanic White respondents to have had a fecal occult blood test (FOBT) during the preceding year (11.5% vs 20.1%). Similarly, after adjustment for SES and other health care indicators, a multiethnic population study showed underuse of CRC screening among AAPIs aged 50 to 64 years.<sup>12</sup>

Lee-Feldstein et al<sup>13</sup> examined factors related to CRC mortality in a group of 1329 multiethnic Medicare patients from a single geographic area and found that AAPIs experienced significantly greater CRC mortality than did White patients after adjustment for stage at diagnosis, tumor location, hospital type, type of health insurance, and sociodemographic indicators. These authors did not discuss differences in genetic predisposition to CRC or rates of CRC screening among AAPIs, and thus unmeasured cultural attributes may have contributed to the increased risks observed.

Few cross-sectional studies<sup>14–17</sup> have attempted to disentangle the underlying attributes accounting for differences in CRC screening rates among certain Asian subgroups, but some have indicated that greater acculturation, increased physician recommendation, and higher SES are significantly associated with increased screening rates. How-

ever, results are difficult to interpret because these studies have relied on different measures of acculturation and CRC screening behavior. Given the great diversity within AAPI communities with respect to historical, cultural, linguistic, and socioeconomic characteristics,<sup>18</sup> it is unknown whether these findings can be generalized to Japanese Americans. Furthermore, the fact that CRC incidence rates among Japanese men and women between the ages of 30 and 54 years have been shown to be 18% and 42% higher, respectively, than rates among US non-Hispanic White men and women<sup>1</sup> in the same age group suggests that health education and community outreach efforts should be extended to younger age groups.

Andersen's model of health care utilization<sup>19,20</sup> has been widely used to identify priority areas of intervention for improving the use of CRC screening. For example, some studies have examined the effects of health insurance or urban/rural residence on detection of CRC and linked lack of insurance or rural area of residence to late-stage diagnosis.<sup>21,22</sup> Andersen included measures of individual health risks as well as a range of other measures that influence health behavior<sup>23–26</sup> and grouped these factors into 3 categories: predisposing, enabling, and need related. In some of the cross-sectional studies<sup>27–29</sup> explicitly applying Andersen's model, the pattern of

results has been consistent: health insurance coverage, urban/rural residence, regular access to care, and availability of medical providers appear to be important predictors of various cancer screening behaviors and access to primary care.

Whether investigated in isolation or as part of a behavioral theory (i.e., the Health Belief Model [HBM]<sup>30</sup> or other models of behavioral change), some health beliefs, such as perceived susceptibility to CRC and perceived barriers to CRC screening, have shown consistent correlations with CRC screening participation or intention.<sup>31–37</sup> The same is true of physician recommendations to undergo screening. In this study, I drew on Andersen's model to evaluate associations between probable correlates of screening and CRC screening participation among US Japanese residents 30 years and older.

## METHODS

### Sample and Design

I conducted a cross-sectional survey study by mail between June and August 2001 using 2-stage equal size cluster sampling to obtain a random sample of US Japanese residents, more than 90% of whom live in urban areas.<sup>38</sup> The sample used was obtained from a commercially available mailing list of Japanese residents in which information on state, city, and zip code of residence, but not gender, was available for extraction. Another publicly available Asian American household database<sup>39</sup> was used to supplement estimations of numbers of Japanese residents according to age group, state, county, and zip code.

To reduce the effect of certain unmeasured environmental factors, including Japanese community sizes by metropolitan area and state,<sup>39</sup> state-level managed care penetration rates in 1996,<sup>40</sup> and state-specific prevalence rates of CRC screening in 1997,<sup>41</sup> I focused on major metropolitan areas in 4 states: Illinois, Massachusetts, New Jersey, and Washington. These 4 states were similar in terms of the environmental factors just mentioned. In the primary stage of sampling, I selected a random sample of 20 zip codes from the selected metropolitan areas. Then from this randomly selected sample, I selected 800 names

of individuals based on a targeted sample size of 360, an expected return rate of 50%, and 5% sampling error.<sup>42</sup>

Eligible participants were those 30 years and older who could read and comprehend Japanese and/or English and had never been diagnosed with CRC. My use of the total design survey method<sup>43</sup> allowed participation to be completely anonymous and voluntary. The survey instrument was developed in English, translated into Japanese, back-translated, reconciled, and pilot tested for refinement. Accompanying the bilingual questionnaire was a self-addressed, stamped return envelope; an introductory letter; and a prestamped postcard with an identification number linked to the respondent's name. A reminder postcard was sent to all recipients of the original mailing 1 week later. Second and third follow-up mailings were sent to nonrespondents 3 weeks and 7 weeks after the original mailing.

### Variables of Interest

The dependent variables assessed were 2 types of CRC screening practices—fecal occult blood tests (FOBTs) and sigmoidoscopy/colonoscopy—concordant with the current clinical practice guidelines of the American Cancer Society (ACS).<sup>44</sup> These variables were modeled on similar variables used in the 1999 BRFSS questionnaire.<sup>45</sup> The independent variables included were selected because of their congruence with the models used (i.e., the HBM<sup>30</sup> and Andersen's model of health care utilization<sup>19,20</sup>) and because previous research had related them to CRC screening behaviors among members of ethnic minority groups.<sup>46</sup> These variables were grouped into the following components: predisposing, enabling, and need related.

The predisposing component includes sociodemographic characteristics and health beliefs, factors that exist before the onset of an illness or need for health care.<sup>19,20</sup> The predisposing factors assessed in this study were age, gender, education, marital status, acculturation status (as measured via self-estimated English-language skills on a 5-point Likert scale), family history of CRC, perceived susceptibility, perceived benefits of screening, and perceived psychological costs of screening (fear, embarrassment, and concerns about discomfort).

While measures of acculturation that focus only on communication resources appear to have an advantage over broader measures of acculturation,<sup>47–49</sup> I favored the selection of English-language skills as a single measure of acculturation, given the strong linear relationship in the present sample between this attribute and length of residence in the United States (Pearson  $r = .73$ ,  $P < .01$ ). I adapted items concerning health beliefs from the Health Belief Scales<sup>50–52</sup> and modified them to measure perceived susceptibility to, benefits of, and psychological costs of CRC screening.

The enabling component reflects an individual's means for securing needed health services through personal and/or community resources.<sup>19,20</sup> I included, in this category, health insurance coverage, usual source of care, and social support. I adapted items concerning social support from a single-dimension social support scale<sup>53</sup> that had previously been used in a study of breast cancer screening behavior.<sup>54</sup>

The presence of predisposing and enabling determinants is a necessary condition for the use of health services, but their presence is not sufficient absent a perceived or evaluated need.<sup>19,20</sup> The need-related factors assessed in the present study were self-rated presence and intensity of gastrointestinal symptoms (according to the index described in Table 1) and physician recommendation for CRC screening.

## STATISTICAL ANALYSIS

Bivariate  $\chi^2$  analyses and odds ratios were used to document the crude relationship between each independent variable and CRC screening tests. Multiple logistic regression in combination with maximum likelihood estimation was used to model the association between each independent variable and outcome measure. The modeling strategy included estimation of a full model including the 2-way interaction terms between variables with bivariate significance, stepwise removal of nonsignificant terms, and examination of differences in the log-likelihood ratio test for the logistic models.

Standard diagnostic techniques were used to test for multicollinearity, and the model

**TABLE 1—Characteristics of the Study Sample (n = 305)**

Characteristic	No. or Mean (% or SD)	1990 census <sup>a</sup> %
<b>State</b>		
Massachusetts	64 (20.9)	
New Jersey	80 (26.1)	
Illinois	77 (25.2)	
Washington	85 (27.8)	
<b>Gender</b>		
Male	188 (61.4)	41.8
Female	118 (38.6)	57.4
<b>Age, y, mean</b>		
	52.3 (±15.3)	
<b>Age group, y</b>		
30–39	72 (23.5)	32.0
40–49	78 (25.5)	25.4
50–59	61 (29.9)	12.3
60–69	45 (14.7)	16.4
70–79	27 (8.8)	9.8
≥80	23 (7.5)	3.3
<b>Marital status</b>		
Married/cohabiting	216 (70.6)	62.3
Other	90 (29.4)	38.7
<b>Type of health insurance</b>		
Medicare/Medicare-HMO	51 (16.7)	
Medicaid	5 (1.6)	
HMO/commercial plan	231 (75.5)	
No insurance or self-pay	19 (6.2)	
<b>Language proficiency</b>		
Speaks Japanese only	12 (3.9)	
Speaks Japanese better than English	179 (58.5)	
Speaks Japanese and English equally well	65 (21.2)	
Speaks English better than Japanese	29 (9.5)	
Speaks English only	21 (6.9)	
<b>Educational level</b>		
High school or less	69 (22.5)	62.1
Associate degree	34 (11.1)	7.4
Bachelor's degree	131 (42.8)	22.1
Master's/doctoral degree	72 (23.5)	6.6
<b>Family history of CRC</b>		
Yes	32 (10.5)	
No	274 (89.5)	
<b>Frequency of gastrointestinal symptoms<sup>b</sup></b>		
Every day	3 (1.0)	
Most but not all days	8 (2.6)	
Occasionally, but not most days	46 (15.0)	
Rarely	142 (46.4)	
Never	107 (35.0)	

Continued

**TABLE 1—Continued**

<b>Usual source of care</b>	
Yes	253 (83.7)
No	53 (17.3)
<b>Language spoken at usual source of care</b>	
Mostly Japanese	95 (37.5)
Mostly English	158 (62.5)
<b>Social support rating<sup>c</sup></b>	
Strongly disagree	11 (3.6)
Disagree	24 (7.8)
Neither agree nor disagree	47 (15.4)
Agree	98 (32.0)
Strongly agree	126 (41.2)
<b>Length of US residence, y</b>	
Less than 8	67 (21.9)
9–16	77 (25.5)
17–24	39 (12.7)
25–36	44 (14.4)
More than 37	78 (25.5)
<b>FOBT in past 2 years</b>	
Yes	113 (36.9)
No	193 (63.1)
<b>Reason for FOBT</b>	
Screening	102 (91.1)
Diagnostic	7 (6.3)
Other	3 (2.7)
<b>SIG/COL in past 5 years</b>	
Yes	80 (26.1)
No	226 (73.9)
<b>Reason for SIG/COL</b>	
Screening	60 (75.0)
Diagnostic	20 (25.0)
<b>Physician advised screening</b>	
Yes	69 (22.6)
No	236 (77.4)

Note. Physician recommendation information was missing for 1 person. FOBT = fecal occult blood test; SIG/COL = sigmoidoscopy/colonoscopy; CRC = colorectal cancer.

<sup>a</sup>Selected sociodemographic data for a 1% national random sample of the Japanese population 30 years and older were extracted from the Integrated Public Use Microdata Series (IPUMS-98).

<sup>b</sup>An additive approach was used to construct the summary index for gastrointestinal symptoms. Gastrointestinal symptoms were assessed by measuring 3 different symptoms (bloating and/or fullness, changes in bowel patterns, and abdominal pain) on 5-point ordinal scales ranging from never (1) to every day (5), summing responses for each symptom, and dividing by number of items answered to obtain a summary score (ranging from 1 to 5).

<sup>c</sup>On the basis of pilot testing, a 1-item social support measure was selected for this study, given the high alpha coefficient (0.94) for the social support scale consisting of 3 items with 5-point Likert scale responses (1 = strongly disagree, 5 = strongly agree). Social support was measured with the following item: "I have someone with whom I can consult about everyday concerns."

performed favorably. Missing data for some demographic and composite measures were imputed with the median value, given that fewer than 2% of cases involved such missing data. Assessments of the influence of cluster sampling illustrated that the intraclass correlation coefficient for the main dependent variable (i.e., CRC screening) was small (0.015), indicating that adjustment of the analyses for within-cluster correlation would not add new information.<sup>55</sup>

## RESULTS

Of the 800 surveys originally mailed, 82 (10%) were returned as undeliverable; 318 completed surveys were returned (a 44% response rate), of which 12 (4%) were deemed unusable because they did not meet inclusion criteria. Of the 318 individuals who returned completed surveys, 177 (56%) had an increased risk of developing CRC as a consequence of their age or medical risks (as defined by ACS<sup>44</sup>). The demographic distribution of the study sample was similar to the distribution of a 1% national random sample of the US Japanese population 30 years and older<sup>38</sup> in terms of age and marital status but not gender and education. In comparison with this random sample, the present sample included more men and was better educated (Table 1).

### Screening Prevalence and Bivariate Analyses

Overall, 37% of the sample reported having undergone an FOBT in the past 2 years, and 26% reported having undergone a sigmoidoscopy/colonoscopy in the past 5 years. About 90% of FOBT and 75% of sigmoidoscopy/colonoscopy visits were reported as screening rather than diagnostic events. In the case of both types of screening, prevalence rates by age group sharply increased after 60 years but decreased after 80 years (Table 2).

The bivariate analysis focusing on FOBT showed that respondents who were older, male, and married; those who spoke English only; those who had a family history of CRC; those who perceived the least psychological cost of screening; those who had Medicare coverage and had a regular source of care; and those who had received a physician rec-

**TABLE 2—Percentages of Participants Undergoing Colorectal Cancer (CRC) Screening and Bivariate Relationships of Participant Characteristics With Screening Participation (n = 305)**

Characteristic	FOBT in Past 2 Years		SIG/COL in Past 5 Years	
	%	Unadjusted OR (95% CI)	%	Unadjusted OR (95% CI)
<b>Predisposing characteristics</b>				
Age, y				
30–39	23.6**	Reference	2.8**	Reference
40–49	26.9	1.2 (0.6, 2.5)	12.8	5.1 (1.1, 24.4)
50–59	32.8	1.6 (0.7, 3.4)	29.5	14.6 (3.2, 66.3)
60–69	64.4	5.9 (2.6, 13.3)	57.8	47.9 (10.4, 220.0)
70–79	63.0	5.5 (2.1, 14.2)	66.7	70.0 (14.0, 352.7)
≥80	39.1	2.1 (0.8, 5.6)	26.1	12.4 (2.3, 66.6)
Gender				
Male	44.7**	2.5 (1.5, 4.1)	29.8	1.7 (1.0, 2.9)
Female	24.6	Reference	20.3	Reference
Marital status				
Married/cohabiting	42.1*	2.3 (1.3, 3.9)	25.5	0.9 (0.5, 1.5)
Other	24.4	Reference	27.8	Reference
Educational level				
High school or less	34.8	Reference	34.8	Reference
Associate degree	29.4	0.8 (0.3, 1.9)	26.5	0.7 (0.3, 1.7)
Bachelor's degree	34.4	1.0 (0.5, 1.8)	19.1	0.4 (0.2, 0.9)
Master's/doctoral degree	47.2	1.7 (0.8, 3.3)	30.6	0.8 (0.4, 1.7)
Language proficiency				
Speaks Japanese only	25.0*	Reference	8.3**	Reference
Speaks Japanese better than English	32.4	1.4 (0.4, 5.5)	20.1	2.7 (0.3, 21.8)
Speaks Japanese and English equally well	32.3	1.4 (0.4, 5.8)	23.1	3.3 (0.4, 27.1)
Speaks English better than Japanese	58.6	4.3 (0.9, 19.1)	44.8	8.8 (1.0, 77.1)
Speaks English only	66.7	6.0 (1.2, 29.4)	71.4	27.2 (2.9, 257.4)
Family history of CRC				
Yes	62.5*	3.2 (1.6, 6.9)	50.0*	3.3 (1.6, 6.9)
No	33.9	Reference	23.4	Reference
Perceived susceptibility rating <sup>a</sup>				
Strongly disagree	25.0	Reference	22.7*	Reference
Disagree	34.4	1.6 (0.7, 3.7)	20.3	0.9 (0.3, 2.2)
Neither agree nor disagree	38.2	1.9 (0.9, 3.9)	22.9	1.0 (0.5, 2.2)
Agree	46.9	2.6 (1.0, 7.0)	46.9	3.0 (1.1, 8.1)
Strongly agree	50.0	3.0 (0.6, 14.1)	62.5	5.7 (1.1, 27.9)
Perceived benefits rating <sup>a</sup>				
Strongly disagree	50.0	Reference	50.0	Reference
Disagree	25.0	0.3 (0.0, 6.7)	25.0	0.3 (0.0, 6.7)
Neither agree nor disagree	26.7	0.4 (0.0, 3.5)	20.0	0.3 (0.0, 2.6)
Agree	28.3	0.4 (0.0, 2.9)	18.5	0.2 (0.0, 1.7)
Strongly agree	42.1	0.7 (0.1, 5.3)	30.0	0.4 (0.1, 3.1)
Perceived costs rating <sup>a</sup>				
Strongly disagree	60.0*	5.5 (1.2, 26.0)	70.0**	14.0 (2.5, 77.9)
Disagree	57.9	5.0 (1.7, 15.3)	50.0	6.0 (1.7, 20.6)

Continued

ommendation exhibited higher rates of screening. In the case of sigmoidoscopy/colonoscopy, the gender and marital status variables did not reach statistical significance; however, perceived susceptibility and psychological costs, English-language proficiency, and physician recommendation produced larger effects on sigmoidoscopy/colonoscopy screening than on FOBT screening (Table 2).

To allow a more meaningful generalization, I regrouped English-language proficiency (as measured on the self-rated 5-point Likert scale) into 2 categories (speaks English only or speaks English more proficiently than Japanese vs speaks limited English) and entered this variable in the multivariate model. Health belief variables (perceived susceptibility, perceived benefits, and perceived costs), as measured again on a self-rated 5-point Likert scale, were regrouped into 3 categories—low (a rating of strongly disagree or disagree), medium (neither agree nor disagree), and high (strongly agree or agree)—and entered in the multivariate model.

### Multivariate Analyses

The results of the final multiple logistic regression analysis (n=305) are presented in Tables 3 and 4. Physician recommendation, greater acculturation levels, and low perceived costs had independent effects on participation in both FOBT and sigmoidoscopy/colonoscopy screening in multivariate analyses; however, the magnitudes of these effects were larger for sigmoidoscopy/colonoscopy than for FOBT.

In addition, the final multivariate analyses revealed different determinants of FOBT and sigmoidoscopy/colonoscopy, and these determinants explained about 34% and 56% of the variation in each test, respectively. In the case of FOBT, those who were male and those who were married were more likely to have been screened. In the case of sigmoidoscopy/colonoscopy, those who were older and those who perceived they were most susceptible to CRC were more likely to have been screened. Other than health insurance, none of the enabling variables were significantly related to CRC screening. Respondents who had commercial health insurance coverage were more likely than those with other forms of insurance or Medicare coverage to have

TABLE 2—Continued

Neither agree nor disagree	37.0	2.2 (0.8, 5.7)	26.0	2.1 (0.7, 6.5)
Agree	31.7	1.7 (0.6, 4.6)	15.8	1.1 (0.3, 3.7)
Strongly agree	21.4	Reference	14.3	Reference
<b>Enabling characteristics</b>				
Type of health insurance				
Medicare/Medicare-HMO	52.9*	9.5 (2.0, 45.5)	45.1*	7.0 (1.5, 33.2)
Medicaid	20.0	2.1 (0.2, 29.5)	40.0	5.6 (0.6, 57.0)
HMO/commercial plan	35.8	4.7 (1.1, 20.1)	23.1	2.6 (0.6, 11.4)
Self-pay or no insurance	10.5	Reference	10.5	Reference
Usual source of care				
Yes	40.3*	2.6 (1.3, 5.2)	29.6*	4.0 (1.5, 10.6)
No	20.8	Reference	9.4	Reference
Social support rating <sup>a</sup>				
Strongly disagree	45.5	Reference	36.4	Reference
Disagree	12.5	0.2 (0.0, 0.9)	20.8	0.5 (0.1, 2.2)
Neither agree nor disagree	40.4	0.8 (0.2, 3.1)	29.8	0.7 (0.2, 2.9)
Agree	38.9	0.7 (0.2, 2.6)	16.3	0.3 (0.1, 1.3)
Strongly agree	38.9	0.7 (0.2, 2.6)	32.5	0.8 (0.2, 3.0)
<b>Need-related characteristics</b>				
Physician recommendation				
Yes	66.7**	5.0 (2.8, 9.0)	71.0**	16.8 (8.8, 32.1)
No	28.4	Reference	12.7	Reference
Frequency of gastrointestinal symptoms				
Every day	66.7	2.6 (0.2, 29)	66.7	4.9 (0.4, 56.1)
Most but not all days	62.5	2.1 (0.5, 9.4)	50.0	2.5 (0.6, 10.4)
Occasionally, but not most days	28.3	0.5 (0.2, 1.1)	19.6	0.6 (0.3, 1.4)
Rarely	31.9	0.6 (0.4, 1.0)	23.2	0.7 (0.4, 1.3)
Never	43.9	Reference	29.0	Reference

Note. Physician recommendation information was missing for 1 person. FOBT = fecal occult blood test; SIG/COL = sigmoidoscopy/colonoscopy; OR = odds ratio; CI = confidence interval; HMO = health maintenance organization.

<sup>a</sup>On a 5-point Likert scale.

\* $P < .01$  ( $\chi^2$  analysis); \*\* $P < .001$  ( $\chi^2$  analysis for the association between undergoing CRC screening during the indicated period and the characteristic in question).

TABLE 3—Adjusted Odds Ratios for Past Fecal Occult Blood Test Screening (n = 305)

	Adjusted Odds Ratio <sup>a</sup>	95% Confidence Interval	P
Age	1.02	1.00, 1.04	.07
Gender (reference: female)	2.0	1.1, 3.6	.02
Married/cohabiting (reference: no)	3.0	1.5, 6.1	<.01
Language proficiency (reference: limited English proficiency)	2.9	1.3, 6.4	<.01
Perceived costs			
Low	2.8	1.3, 6.1	.01
Medium	1.5	0.8, 2.7	.20
High	Reference		
Physician recommendation (reference: no)	3.6	1.8, 6.9	<.001

<sup>a</sup>Adjusted odds ratios were derived from a simultaneous logistic regression equation including age, gender, marital/living status, health insurance, English-language proficiency, education, family history of colorectal cancer, perceived susceptibility, perceived benefits, perceived costs, usual source of care, social support, physician recommendation, and gastrointestinal symptom index.

undergone sigmoidoscopy/colonoscopy screening.

## DISCUSSION

This study provides the first population-based estimates and independent correlates of CRC screening behavior among Japanese residents of the United States. On balance, the present findings are consistent with some of the results of previous research focusing on CRC screening behavior, supporting the inclusion of key elements from the HBM<sup>30</sup> and Andersen's model.<sup>19,20</sup> A strong relationship between physician recommendation and CRC screening behavior was evident in this popu-

lation, in agreement with other studies describing the substantial explanatory power of physician recommendation.<sup>31,33,34</sup> While the strikingly large effect of physician recommendation on CRC screening behavior supports physician persuasion as the most effective means of promoting screening among this population, the question of what can be done to maximize opportunities for physician recommendation needs careful examination.

The subgroup analysis of respondents with elevated risk of CRC (n = 177) as a consequence of older age or personal medical history revealed that the majority (63%) reported never having received advice from a physician, even though an overwhelming ma-

majority (84%) of the sample had regular access to medical care. This result demonstrates that regular access to a physician among high-risk individuals does not ensure a screening recommendation from that physician. A study of English-speaking patients with CRC<sup>56</sup> showed poor communication regarding familial CRC risk and need for screening not only between physicians and patients but also between patients and their at-risk relatives, substantiating the need for innovative efforts in communicating personal risks, particularly among higher risk populations.

Communication between physicians and patients regarding cancer risk is often shaped by individual cultural norms. A cross-national study<sup>57</sup> showed that 80% of US physicians and patients agreed that doctors should inform their patients of their cancer diagnosis and should allow them to decide whether their family should be told, whereas high percentages of Japanese physicians (80%) and Japanese patients (65%) agreed that doctors should inform patients'

**TABLE 4—Adjusted Odds Ratios for Past Sigmoidoscopy/Colonoscopy Screening (n = 305)**

	Adjusted Odds Ratio <sup>a</sup>	95% Confidence Interval	P
Age	1.07	1.03, 1.11	<.001
Language proficiency (reference: limited English proficiency)	3.7	1.3, 10.1	.01
Perceived susceptibility			
Low	Reference		
Medium	0.9	0.4, 2.1	.88
High	4.3	1.3, 14.1	.01
Perceived costs			
Low	14.1	4.9, 40.3	<.001
Medium	2.8	1.1, 6.6	.02
High	Reference		
Insurance coverage			
Medicare/ Medicare-HMO	Reference		
Medicaid	0.06	0.003, 1.7	.09
HMO/commercial plan	4.0	1.2, 13.2	.02
No insurance or self-pay	2.9	0.4, 20.8	.29
Physician recommendation (reference: no)	13.7	6.1, 30.6	<.001

HMO - health maintenance organization.

<sup>a</sup>Adjusted odds ratios were derived from a simultaneous logistic regression equation including age, gender, marital/living status, health insurance, English-language proficiency, education, family history of colorectal cancer, perceived susceptibility, perceived benefits, perceived costs, usual source of care, social support, physician recommendation, and gastrointestinal symptom index.

family members of the diagnosis and should allow them to decide whether the patients themselves should be told. Similarly, a cross-cultural survey involving Japanese American and Japanese respondents<sup>58</sup> documented the importance of family involvement in health care decisionmaking irrespective of acculturation status. To encourage effective physician recommendation in this population, cultural aspects of communication about cancer need to be considered.

Acculturation status was also consistently associated with both FOBT and sigmoidoscopy/colonoscopy screening after demographic factors, SES, health insurance coverage, and

CRC-specific health beliefs had been controlled (as mentioned earlier, this variable had a larger impact on sigmoidoscopy/colonoscopy screening than on the FOBT). One could speculate that those who speak English proficiently might be more skilled in seeking health information and using the medical system than those who speak limited English, given that a decision to undergo sigmoidoscopy/colonoscopy screening may involve more intensive communication with medical and insurance personnel.

Moreover, as indicated in a prospective cohort study conducted by Tu et al.,<sup>59</sup> underuse of cancer screening among AAPIs may be due more to linguistic and attitudinal barriers related to acculturation than to financial barriers. Inability or hesitancy to discuss health concerns in one's nonnative tongue may arguably perpetuate racial/ethnic disparities in CRC screening behavior. It would be helpful not only to make sensitive translations of existing health education materials available for those at a low level of English-language proficiency but also to explore with such individuals ways to overcome perceived barriers to making an informed screening decision. Thus, interventions leading health care providers to communicate more effectively with nonnative speakers alone could result in a substantial increase in CRC screening compliance rates among immigrant or less acculturated populations.

In terms of outreach efforts, language training for immigrants as well as assertiveness training in regard to medical communication on the part of the patient should be an important public health priority. Additional studies are needed to explore clinical and community resources and policies that might improve communication and accessibility of CRC screening among the Japanese community.

This study also sheds light on the cognitive issues involved in CRC screening behavior. Perceived susceptibility and psychological costs were strongly associated with sigmoidoscopy/colonoscopy screening in the adjusted model. Given the better accuracy and more invasive nature of sigmoidoscopy/colonoscopy relative to FOBT, it is plausible that the decision to undergo sigmoidoscopy/colonoscopy screening is prompted by lower

psychological costs and greater perceived susceptibility. Such a suggestion is concordant with the results of other studies involving the use of HBM, in which perceived costs were the most reliable predictor of preventive health behavior, followed by perceived susceptibility.<sup>60,61</sup>

Among the US Japanese population, failure to undergo screening is probably in part a function of psychological barriers, including fear of discovering cancer, embarrassment, and concerns about discomfort. High levels of psychological distress, including fear and anxiety regarding cancer, have often been found to be associated with avoidance of other types of cancer screening,<sup>62,63</sup> and such beliefs, if not altered, can potentially have far-reaching negative consequences in terms of screening compliance. Further studies assessing the relevance of psychological barriers to CRC screening among underserved populations may prove useful.

Finally, this study also revealed a positive association between commercial health insurance coverage and participation in sigmoidoscopy/colonoscopy screening, suggesting that this type of coverage may increase endoscopic examination rates among the Japanese American population. Although the explanation for this finding is uncertain and merits further exploration, previous studies have suggested that individuals with commercial health insurance coverage are more likely to undergo cancer screening.<sup>12,21</sup>

Several limitations of this study should be considered when interpreting the present results. First, the use of a Japanese mailing list as a sampling frame may have produced a biased sample, including limited coverage of the female population. However, given that the US Japanese population is small and geographically dispersed, other options were less practical and more costly.

Second, this study's reliance on self-reported data may have produced bias. However, a study focusing on concordance between patient self-reports and medical records showed that self-reports of CRC screening behavior were accurate irrespective of age, gender, ethnicity, or family history of CRC.<sup>64</sup> Third, the data used in this research were cross sectional, and thus it is beyond the present scope to establish causality.

Finally, the 44% response rate raises the issue of nonrespondents' viewpoints. The distribution of educational background in the present sample indicated self-selection into the survey and an upward bias in education relative to 1990 census data for the Japanese American population as a whole.<sup>38</sup> Thus, there is a need for further replication of the findings to verify the associations observed.

In conclusion, strategies aimed at influencing CRC screening among Japanese Americans should include efforts to alter this population's attitudinal and linguistic barriers in regard to screening, but they must also target primary care physicians and public health educators to identify and address resistance and potential barriers to making screening recommendations. CRC screening rates among members of the present sample who were 50 years and older were much higher than might be expected for AAPIs<sup>11</sup> and somewhat similar to the reported rate range for White populations (40%–50%).<sup>34,46,65</sup> While such screening rates appear to meet national goals,<sup>66</sup> the much higher incidence of CRC among Japanese Americans than among the White population<sup>1</sup>—particularly in the case of US-born Japanese men, whose rate is about 60% higher than that of US-born White men<sup>6</sup>—suggests the need for more targeted and aggressive screening strategies for this group.

Active efforts focusing on physician recommendation are likely to have the greatest impact on rates of CRC among Japanese residents of the United States. Improving communication between providers and patients, especially less acculturated patients, would go a long way toward increasing adherence and alleviating potential barriers such as fear and embarrassment or misunderstanding owing to limited English-language proficiency. As our society becomes more diverse, cultural competency will have an increasing impact on CRC screening usage and outcomes. ■

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#### Human Participant Protection

Ethical clearance for this study was obtained from the institutional review board at New York University. The study design ensured anonymity, and tacit consent was provided by all participants.

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# Vision Impairment and Hearing Loss Among Community-Dwelling Older Americans: Implications for Health and Functioning

John E. Crews, DPA and Vincent A. Campbell, PhD

Sensory problems are common experiences within the older US population. Of people aged  $\geq 70$  years, 18% report blindness in 1 or both eyes or some other trouble seeing, 33.2% report problems with hearing, and 8.6% report problems with both hearing and seeing.<sup>1</sup> Precisely because these experiences are so common, they are often overlooked or dismissed.<sup>2</sup> Moreover, normal age-related changes in hearing and vision may be confused with abnormal sensory changes that can compromise function. Likewise, abnormal changes due to eye and ear pathology may be confused with normal age-related sensory changes.

Hearing and vision problems are not manifest disabilities, and both can lead to misdiagnosis or misunderstanding. For example, an older person with vision problems may appear timid, hesitant, or confused, especially when confronted with a new situation.<sup>3</sup> Similarly, older people with hearing loss may miss the nuances of conversation and appear confused, creating unjustified impatience on the part of those with whom they are speaking.<sup>4</sup> These experiences may lead to isolation, disappointment, and frustration.<sup>5</sup>

When decrements in vision and hearing exceed normal age-related changes that are due to eye pathology, they may begin to compromise an older person's ability to carry out routine activities that define social roles and quality of life.<sup>6</sup> Either hearing or vision loss can affect the most common and simple tasks. Sensory decline may compromise one's ability to hear whispered conversation or side remarks, write notes, read the newspaper, and recognize facial expressions.

The relation between vision and various health conditions and activity limitations among older people is well documented, but few studies are population based. Diminished vision is associated with decreases in

**Objectives.** We investigated the health, activity, and social participation of people aged 70 years or older with vision impairment, hearing loss, or both.

**Methods.** We examined the 1994 Second Supplement on Aging to determine the health and activities of these 3 groups compared with those without sensory loss. We calculated odds ratios and classified variables according to the *International Classification of Functioning, Disability and Health* framework.

**Results.** Older people with only hearing loss reported disparities in health, activities, and social roles; those with only vision impairment reported greater disparities; and those with both reported the greatest disparities.

**Conclusions.** A hierarchical pattern emerged as impairments predicted consistent disparities in activities and social participation. This population's patterns of health and activities have public health implications. (*Am J Public Health*. 2004; 94:823–829)

leisure activities,<sup>7,8</sup> Instrumental Activities of Daily Living (IADL) performance and social function,<sup>2</sup> Activities of Daily Living (ADL),<sup>9</sup> and compromised mobility<sup>10,11</sup>; it is also associated with increases in hip fractures,<sup>12</sup> falls,<sup>13</sup> depression,<sup>14,15</sup> physician visits and hospitalizations,<sup>16</sup> mortality,<sup>17</sup> and family stress.<sup>18–20</sup>

Hearing loss is associated with decreased functional and psychosocial impairments<sup>21</sup>; increased social isolation,<sup>22</sup> depression,<sup>23,24</sup> and rates of dementia<sup>25</sup>; it is also associated with accelerated cognitive decline in dementia.<sup>26</sup> Declines in vision and hearing are associated with decreased quality of life,<sup>27</sup> increased physical disability measured by IADL among women,<sup>28</sup> imbalance,<sup>29,5</sup> falls,<sup>30,31,13</sup> hip fracture,<sup>12</sup> and mortality.<sup>32,33</sup>

Few investigators have examined the discrete concerns associated with sensory loss as defined by hearing loss, vision impairment, and both vision impairment and hearing loss. Two recent articles are of particular interest. Keller et al.<sup>34</sup> examined ADL and IADL among a group of 576 older people seen at the University of Nebraska Medical Center. Vision impairment was defined as a near visual acuity of 20/70 or less, and hearing was measured by a whisper test. In this study,

51% of subjects were classified as having a hearing impairment only; 5% had a vision impairment only; 13% had a dual sensory impairment, and 32% had none. These 4 groups were compared in terms of mean ADL and IADL scores. Participants with sensory impairments showed diminished functional status as measured by ADL and IADL. Those with combined vision impairment and hearing loss demonstrated the greatest differences in functional status. The sample was not population based.

A population-based investigation, however, by Reuben et al.<sup>35</sup> examined the National Health and Nutrition Examination Survey (NHANES I) to determine the relation between vision and hearing loss within a 10-year period and mortality and overall functional decline. The NHANES I provided a large sample (n=5677) whose subjects, aged 55–74 years, were followed for a decade. Those with hearing loss, vision impairment, and both vision impairment and hearing loss demonstrated higher rates of mortality, ADL dependency, and IADL dependency than did people without sensory impairment 10 years after collection of baseline data. Those with combined vision and hearing problems demonstrated the greatest declines in function

and the greatest rates of mortality. Those who acquired vision and hearing problems after baseline data were collected were not identified, and thus changes in their function were not recorded.

Comprehension of the magnitude of sensory problems in the older US population and the impact of these changes on this population's behaviors are important public policy and public health concerns in terms of surveillance, research, and intervention design.

**METHODS**

**Second Supplement on Aging**

The National Center for Health Statistics of the Centers for Disease Control and Prevention and the National Institute on Aging of the National Institutes of Health coproduced the Second Supplement on Aging (SOA-II) 1994 in September 1998.<sup>36</sup> The SOA-II closely replicates the 1984 Supplement on Aging (SOA) and the first Longitudinal Study on Aging (LSOA) that followed a cohort of older people in 3 waves. The LSOA allowed researchers to gain insight into changes in health and disability, social supports, as well as sex and socioeconomic differentials in health. The SOA-II was designed to build upon the knowledge gained from the SOA. In addition to providing comparisons with cross-sectional data on a population from the middle 1990s, the SOA-II provided baseline data for a second longitudinal study.<sup>36</sup>

Data for the SOA-II were obtained from 4 sources: (1) the 1994 National Health Interview Survey (NHIS) Core Questionnaire, (2) the Access to Care Supplement to the 1994 NHIS, (3) Phase 1 of the National Health Interview Survey on Disability (NHIS-D), and (4) Phase 2 of the NHIS-D. Information for the first 3 sources was gathered during 1994. Data for the NHIS-D were collected in 2 phases. Phase 1 data were collected in 1994, and a series of screening criteria were used to identify people selected for the second phase of the NHIS-D, also known as the Disability Followback Study. Data for the NHIS-D were collected 7–17 months after the initial survey.

A total of 9447 people were interviewed for the SOA-II; all participants were aged ≥70 years. The SOA-II provides self-reported infor-

mation from older, noninstitutionalized civilians. Proxy responses (14.4% of the total) were accepted when a respondent was incapable of completing the interview. Data were weighted for age, sex, race, and nonresponse in order to produce national estimates. Due to the complex stratified cluster sampling design employed by the SOA-II, SUDAAN<sup>37</sup> was used to analyze data. The Taylor linearization “with replacement” design option was used to calculate standard error in order to provide more accurate variance estimates.

**Sensory Impairment Variables in the SOA-II**

For this study, we created 4 groups for analysis: those reporting hearing problems only, those reporting vision problems only, those reporting both vision and hearing problems, and those reporting no vision or hearing problems. The SOA-II contains 11 variables regarding vision. Two questions, respectively, concern diagnosis (cataract and glaucoma), blindness (in 1 or both eyes), and eyeglasses (used and prescribed); additional questions apply to cataract surgery, lens implant(s), contacts, and use of magnifiers. A global question deals with “trouble seeing even with glasses.” For this analysis, we cre-

ated a summary variable for vision problems that includes a positive response to the following characteristics: “blindness in one eye,” “blindness in both eyes,” and “trouble seeing even with glasses.”<sup>38,39</sup>

The SOA-II contains 6 questions about hearing, including “deafness in one ear,” “deafness in both ears,” “any other trouble hearing,” “used hearing aid in past 12 months,” “used hearing aid in past 2 weeks,” and “cochlear implant.” For this analysis, we created a summary variable for “hearing problem” for any positive response to the variables “deafness in one ear,” “deafness in both ears,” and “any other trouble hearing.” No single variable characterizes both hearing and vision loss; therefore, we have used a positive response to both the hearing and vision summary variables to define compromised hearing *and* vision. For the estimated population, 58.0% reported no sensory impairment; 24.4% reported hearing impairment only, 9.4% reported vision impairment only, and 8.2% reported both vision and hearing impairment. Of the total estimated population, 89.9% were White, 7.7% Black, and 2.4% “other”; 52.6% were married; 36.9% were widowed; and 40.1% were males (Table 1).

**TABLE 1—Demographic Characteristics of Community-Dwelling Adults Aged ≥70 Years, by Sensory Impairment: NHIS, 1994<sup>36</sup>**

	Percentage With Impairment				Total Sample (N = 9447)
	None (n = 5485)	Hearing (n = 2289)	Vision (n = 894)	Vision and Hearing (n = 779)	
Respondents	58.0	24.4	9.4	8.2	100.0
Gender					
Men	36.8	50.9	30.4	42.6	40.1
Women	63.2	49.1	69.6	57.4	59.9
Race					
White	88.5	93.8	86.1	92.2	89.9
Black	9.0	4.3	11.5	4.7	7.7
Other	2.5	1.9	2.4	3.2	2.4
Marital status					
Married, living with spouse	53.8	56.0	42.7	45.5	52.6
Married, spouse out of home	1.2	1.2	1.1	9.0	1.2
Widowed	35.3	35.0	43.8	46.0	36.9
Divorced	5.0	4.0	5.5	3.6	4.7
Separated	0.7	0.4	2.1	0.8	0.8
Never married	4.1	3.5	4.8	3.2	3.9

**TABLE 2—Health Status of Community-Dwelling Adults Aged ≥ 70 Years, by Sensory Impairment: NHIS, 1994<sup>36</sup>**

	Percentage With Impairment			
	None	Hearing	Vision	Vision and Hearing
Excellent	16.4	14.4	9.5	7.7
Very good	26.1	21.7	18.5	12.0
Good	34.1	35.6	34.3	34.2
Fair	16.7	20.4	22.4	27.5
Poor	6.7	8.0	15.3	18.5

## RESULTS

### Health Conditions and Comorbidities

While the magnitude of the problem facing older people who experience sensory impairments is defined by these proportions, these population estimates do not characterize the effects of vision and hearing loss as older people perform various tasks (e.g., reading print or hearing conversation) or social roles (e.g., getting together with friends and relatives). Because valued activities and social roles generally define quality of life, sensory impairment has the capacity to greatly restrict older people. Knowing the patterns of these restrictions may lead to the development of public health and rehabilitation interventions that ameliorate the limitations created by vision and hearing loss. In this analysis, we employed the *International Classification of Functioning, Disability and Health* (ICF) as a conceptual framework. The ICF makes distinctions among impairments, activity limitations, participation restrictions, and the environment, and these concepts are useful for portraying the multidimensional experience of older people who report sensory loss.<sup>40</sup>

Older people with vision impairment only were less likely to report their health as “excellent” (9.5% vs 16.4%) or “very good” (18.5% vs 26.1%) than were those who do not report sensory problems (Table 2). In addition, older people who reported vision problems were more likely to report their health as “poor” than people without sensory problems (15.3% vs 6.7%). Similarly, older people reported hearing loss only also were

less likely to report their health as “excellent” (14.4% vs 16.4%) or “very good” (21.7% vs 26.1%) than were those without sensory loss. Older people who reported both vision impairment and hearing loss reported much lower rates of excellent health (7.7% vs 16.4%) and higher rates of poor health (18.5% vs 6.7%).

Table 3 compares older people who reported sensory impairment (vision problems only, hearing problems only, and vision and hearing problems only) with older people who did not report sensory impairments, in terms of comorbid and related conditions. In all cases, a higher proportion of people with vision problems reported comorbid and secondary conditions. They were 1.8 times more likely to have experienced a fall in the past 12 months (26.0% vs 16.5%), 1.7 times as likely to have experienced a broken hip (6.3% vs 3.8%), and 2.6 times more likely to have experienced a stroke (15.0% vs 6.4%). Heart disease (28.8% vs 16.7%) and hypertension (54.3% vs 42.5%) were reported in higher proportions among those with vision problems.

Across the same variables, people with hearing loss only reported higher rates of comorbid and secondary conditions than did people who did not have sensory loss. Those with hearing loss were 1.7 times more likely to have experienced falls (25.0% vs 16.5%), 1.7 times more likely to report heart disease (25.7% vs 16.7%), and 1.4 times more likely to report stroke (8.9% vs 6.4%). People with hearing loss reported higher rates of hypertension and broken hips, but these differences were not significant.

Older people with both vision and hearing loss were 3.0 times more likely to have fallen in the past 12 months than were people without vision or hearing problems (37.6% vs 16.5%), and 2.1 times more likely to have broken a hip (7.4% vs 3.8%). They were 1.5 times more likely to report hypertension (53.2% vs 42.5%), 2.4 times more likely to report heart disease (32.6% vs 16.7%), and 3.6 times more likely to have had a stroke (19.7% vs 6.4%).

Older people with visual impairment were 2.0 times more likely to report being frequently depressed or anxious than were older people without sensory problems (12.0% vs

5.8%). Although not significant, those with hearing loss only reported slightly higher rates of depression (8.0% vs 5.8%) than did people without sensory loss, and people with both vision and hearing loss only were 2.7 times more likely to report depression.

### Activity Limitations

The ICF defines activity as “the nature and extent of performance of a function by a person” and activity limitations as “problems of the performance of activities in nature, duration, and quality.”<sup>40</sup> Older people with vision impairments only were 3.0 times as likely to report difficulty walking than people without sensory problems (39.0% vs 17.8%), while those with vision problems were 3.3 times more likely to report difficulty getting outside than people without sensory problems (25.1% vs 9.3%) (Table 3). Likewise, people with vision impairments were 2.8 times more likely to report difficulty getting into and out of a bed or chair (19.4% vs 8.0%), 3.1 times more likely to report difficulty managing medication (10.8% vs 3.7%), and 3.5 times more likely to report difficulty preparing meals (19.2% vs 6.3%).

Older people with hearing loss only also reported greater difficulties with activities than did people without sensory problems. These limitations were not as great as those among older people with vision impairments. One fourth (24.5%) of people with hearing loss reported difficulty walking compared with 17.8% of those who did not report hearing loss. In addition, people who reported hearing loss were 1.3 times more likely to report difficulty getting outside (11.8% vs 9.3%), 1.5 times more likely to report difficulty getting into and out of a bed or chair (11.7% vs 8.0%), and 1.6 times more likely to report difficulty managing medication (5.7% vs 3.7%) than were people without sensory problems.

Older people with both vision and hearing impairment were 4.3 times more likely to report difficulty walking (48.2% vs 17.8%), 4.7 times more likely to report difficulty getting outside (32.4% vs 9.3%), and 3.8 times more likely to report difficulty getting into or out of a bed or chair (24.8% vs 8.0%). In addition, this group was 4.7 times more likely to report difficulty preparing meals (23.9% vs 6.3%)

**TABLE 3—Health Conditions, Activity Limitations, and Social Participation of Community-Dwelling Adults Aged ≥ 70 Years, by Sensory Impairment: NHIS, 1994<sup>36</sup>**

Health Condition	Hearing Loss Only			Vision Impairment Only			Both Hearing and Vision Loss			No Vision or Hearing Loss, %
	%	OR	95% CI	%	OR	95% CI	%	OR	95% CI	
Diabetes	12.8	1.4	1.1-1.6	17.9	2.0	1.6-2.5	18.6	2.1	1.7-2.5	9.8
Arthritis	62.0	1.4	1.3-1.6	66.3	1.7	1.4-2.1	71.3	2.2	1.9-2.6	53.2
Hypertension	44.5	1.1	1.0-1.2 <sup>a</sup>	54.3	1.6	1.4-1.9	53.2	1.5	1.3-1.8	42.5
Heart disease	25.7	1.7	1.5-1.9	28.8	2.0	1.7-2.4	32.6	2.4	2.0-2.8	16.7
Other heart condition	8.2	1.3	1.1-1.6	11.4	1.9	1.5-2.4	11.6	2.0	1.5-2.6	6.2
Stroke	8.9	1.4	1.2-1.8	15.0	2.6	2.1-3.2	19.7	3.6	2.9-4.4	6.4
Depression	8.0	1.2	0.9-1.5 <sup>a</sup>	12.0	2.0	1.5-2.6	16.0	2.7	2.1-3.5	5.8
Broken hip	4.5	1.2	0.9-1.5 <sup>a</sup>	6.3	1.7	1.2-2.3	7.4	2.1	1.5-2.7	3.8
Fallen in past 12 mos	25.0	1.7	1.5-1.9	26.0	1.8	1.5-2.1	37.6	3.0	2.6-3.6	16.5
Injured from fall	54.5	0.9	... <sup>a</sup>	55.7	1.0	0.7-1.4 <sup>a</sup>	57.5	1.1	0.8-1.4 <sup>a</sup>	56.0
Osteoporosis	8.0	1.0	0.9-1.2 <sup>a</sup>	11.4	1.5	1.2-2.0	16.3	2.3	1.7-3.1	7.7
Confused	7.4	1.4	1.1-1.8	11.4	2.2	1.7-3.0	14.0	2.8	2.2-3.8	5.4
Activity limitation										
Unable to walk quarter mile	34.9	1.5	1.3-1.7	51.4	2.9	2.5-3.4	60.7	4.2	3.6-5.0	26.7
Unable to take 10 steps	26.6	1.4	1.2-1.6	43.2	2.9	2.4-3.4	50.1	3.8	2.2-4.5	20.8
Difficulty bathing	13.7	1.4	1.2-1.6	23.4	2.8	2.3-3.3	29.5	3.8	3.2-4.5	10.0
Difficulty dressing	9.2	1.5	1.3-1.8	12.3	2.1	1.7-2.6	19.6	3.6	2.9-4.6	6.3
Difficulty getting out of a bed or chair	11.7	1.5	1.3-1.8	19.4	2.8	2.4-3.4	24.8	3.8	3.0-4.7	8.0
Difficulty walking	24.5	1.5	1.3-1.7	39.0	3.0	2.5-3.5	48.2	4.3	3.7-5.0	17.8
Difficulty going outside	11.8	1.3	1.1-1.5	25.1	3.3	2.7-3.9	32.4	4.7	4.0-5.5	9.3
Difficulty using toilet	5.7	1.2	1.0-1.6 <sup>a</sup>	11.3	2.6	2.1-3.3	12.8	3.0	2.3-3.9	4.6
Difficulty preparing meals	8.9	1.5	1.2-1.8	19.2	3.5	2.8-4.4	23.9	4.7	3.8-5.8	6.3
Difficulty buying groceries	13.8	1.4	1.2-1.6	32.1	4.1	3.4-5.0	36.9	5.1	4.2-6.2	10.3
Difficulty using money	5.9	1.8	1.4-2.3	12.9	4.3	3.3-5.5	16.7	5.8	4.4-7.5	3.4
Difficulty using a telephone	6.4	3.6	2.8-4.6	8.5	4.9	3.6-6.6	14.9	9.1	7.0-12.0	1.9
Difficulty doing light housework	9.5	1.4	1.2-1.7	15.7	2.5	2.0-3.2	21.6	3.7	3.0-4.6	6.9
Difficulty going places	14.9	1.5	1.2-1.7	33.5	4.2	3.5-5.0	36.6	4.8	4.0-5.8	10.7
Difficulty taking medicine	5.7	1.6	1.2-2.0	10.8	3.1	2.3-4.2	13.5	4.0	3.1-5.3	3.7
Social participation										
Visiting with friends	70.9	0.9	0.8-1.0	66.8	0.7	0.6-0.8	63.4	0.6	0.5-0.7	73.9
Phoning friends	75.7	0.6	0.5-0.7	79.8	0.8	0.6-0.9	72.1	0.5	0.4-0.6	83.9
Visiting with relatives	77.6	1.1	1.0-1.3 <sup>a</sup>	73.5	0.9	0.7-1.0 <sup>a</sup>	75.2	1.0	0.8-1.1 <sup>a</sup>	75.9
Phoning relatives	84.8	0.8	0.7-0.9	85.5	0.8	0.6-1.0 <sup>a</sup>	81.2	0.6	0.5-0.7	88.1
Attending church	49.3	0.8	0.7-0.9	43.6	0.7	0.6-0.8	41.7	0.6	0.5-0.7	53.8
Going to movies	25.8	0.8	0.7-0.9	21.1	0.6	0.5-0.7	19.5	0.6	0.4-0.7	30.7
Eating out	65.9	1.0	0.9-1.1 <sup>a</sup>	56.3	0.7	0.6-0.8	55.8	0.6	0.6-0.8	66.0
Getting exercise	38.8	0.9	0.8-1.0 <sup>a</sup>	33.7	0.7	0.5-0.8	32.7	0.7	0.6-0.8	41.8

Note. OR = odds ratio; CI = confidence interval.

<sup>a</sup>Not significant.

and 4.0 times more likely to report difficulty managing medication (13.5% vs 3.7%).

**Participation Restrictions**

Differences in social participation were substantial, although more modest than differences in activity limitations (Table 3). Older people reporting sensory problems were less likely to report visiting friends in the past 2 weeks. Nearly 74% of older people without sensory loss reported visiting friends; 70.9% of those with hearing loss only reported visiting friends; 66.8% of those with vision impairment only reported visiting friends; and 63.4% of those with both vision impairment and hearing loss reported visiting friends. There were no significant differences among the 4 groups regarding visiting with relatives. Older people with hearing loss only were as likely to eat out as those without sensory impairment, but people reporting vision or vision *and* hearing problems were about two thirds as likely to eat out at a restaurant. Older people with both hearing loss and vision impairment reported substantial difficulty sustaining social participation activities; they were, for example, half as likely to phone friends and about two thirds as likely to attend church.

In addition, the SOA-II asked about desired level of social activity—whether the amount of social activity was “too much,” “about enough,” or if the respondent “would like to do more” (Table 4). About one fifth (21.6%) of older people without sensory loss reported having too little social activity. By contrast, about one fourth (25.1%) of older people with hearing loss reported “would like to do more” and about one third of those with vision impairment (31.0%) or vision impairment and hearing loss (33.7%) reported that they “would like to do more.” These responses were consistent with the social participation measures discussed above.

**DISCUSSION**

A hierarchical pattern emerges from our examination of the comorbid conditions and activity limitations among the older US population who reported hearing or vision impairments or loss of both hearing and vision. These findings are consistent with those

**TABLE 4—Level of Social Activity Reported by Community-Dwelling Adults Aged ≥ 70 Years, by Sensory Impairments: NHIS: 1994<sup>36</sup>**

Level of Social Activity	Percentage With Impairment			
	Hearing	Vision	Vision and Hearing	None
Too much	3.1	2.3	3.2	2.4
About enough	71.8	66.7	63.1	76.0
Would like to do more	25.1	31.0	33.7	21.6

found by other investigators.<sup>35,36</sup> Older people who reported only hearing problems demonstrate higher rates of comorbid conditions in relation to their peers without hearing loss. Likewise, older people reported only vision problems demonstrated substantially higher rates of comorbid conditions and substantially greater difficulty in performance of activities than those without sensory impairments or those with hearing impairments only. Older people with both hearing and vision problems reported even greater rates of comorbidities and activity limitation than the other 3 groups.

Because of the confounding relation between comorbidities and activity limitations, neither vision impairment nor hearing loss alone defines the experience of older people who reported sensory impairment. Vision impairment or hearing loss rarely occur in isolation; instead, they occur in the context of other age-related physiologic and psychosocial changes.

One would expect activity limitations to become translated into societal participation restrictions. For example, difficulties in travel would probably increase the difficulty in maintenance of social relationships. The hierarchical patterns among older people who reported hearing loss, vision loss, or both hearing and vision loss were repeated in the selected societal participation measures in this analysis.

The societal participation measures must be interpreted with care because all of the participation questions asked an individual whether he or she had performed a function within the past 2 weeks. Therefore, a positive response to getting together with friends may mean that a respondent has only been with 1 friend once in 2 weeks. Moreover, participation measures inquiring about “visiting with

friends” and “visiting with relatives” were broadly phrased. These questions did not capture the active or passive nature of these encounters. For example, whether the respondent left home to visit (an active role) or whether others came to the respondent’s home to visit (a passive role) is unknown.

In terms of social involvement, obvious differences exist between having a relative drop in once in 2 weeks and having daily interactions. These questions were not sufficiently sensitive to gauge social interaction. The question about level of social activity (“about enough,” “too much,” or “would like to do more”) may be a useful summary measure of social participation. Additionally, it is important to remember that this analysis reports the correlations from cross-sectional data; therefore, the causal sequence cannot be inferred.

These findings underscore the importance of the recently published *Healthy People 2010*<sup>41</sup> goals of primary prevention and rehabilitation in both vision and hearing (Chapter 28) as well as objectives to increase social participation and life satisfaction among all people with disabilities and the removal of environmental barriers (Chapter 6). Common eye conditions, especially diabetic retinopathy, glaucoma, and cataract, respond well to treatment.<sup>42,43</sup> Similarly, routine audiometric screenings or questionnaires remain effective strategies for early identification of hearing problems.<sup>44</sup> Moreover, those in the aging network, which serves a broad range of concerns among older people, need to be mindful of the particular circumstances of older persons’ sensory impairment. Finally, the national vision rehabilitation program (funded under Title VII, Chapter 2 of the Rehabilitation Act of 1973, as amended) may be required to address multiple health and functional concerns.

Further examination of the health implication of these data may be productive given the relation between sensory loss and activity limitations and our hypothesized impact on health outcomes. Examples include examination of the implications of visual impairment on difficulty in meal preparation and nutritional outcomes, the impact on physical conditioning by difficulty in walking, and the ability to manage medication to achieve pharmacologic compliance. These findings also point to concerns regarding older persons’ management of their environment, a concept advanced in the ICF. For example, Long et al.<sup>10</sup> demonstrated the presence of sidewalks as a predictor of walking outside for people with diminished vision. Moreover, standard print size may impede the ability of visually impaired elders to comply with drug therapies.<sup>45</sup> Improvement of the acoustical characteristics of environments by modification of reverberant rooms and noisy ventilation systems is associated with increased capacity to use residual hearing.<sup>5</sup>

In addition, these findings indicate that social roles of older people with bimodal sensory loss may be compromised. Kemp<sup>46</sup> and Gignac and Cott<sup>47(p743)</sup> refer to social participation roles as “valued activities.” These data do not indicate the kinds of strategies older people employ to sustain valued activities in the face of multiple impairments.

These findings suggest 3 areas requiring additional inquiry.

*Activity limitations and secondary conditions.* Additional attention should be given to the relation between activity limitations and conditions and circumstances secondary to sensory impairment. That is, what are the health relations among older people with vision impairment between difficulty walking and general conditioning to hypertension and heart disease? What is the relation among older people with vision impairment between difficulty preparing meals and nutrition?

*Environment and behavior.* Additional attention should be given to the relation of the environment and the behaviors of people who have sensory problems. That is, would the presence of sidewalks and larger print on medicine bottles make a difference in the general health and activities of older people with vision problems? How does environmen-

tal noise hinder elders with hearing impairment from understanding conversations?

**Strategies for participation.** Additional attention should be given to understanding the strategies used by older people to sustain participation in the community. That is, how do older people with activity limitations arrange their lives to continue social participation? What is the nature of the social interactions for elders with sensory impairments? Although not different quantitatively, are these relations qualitatively more dependent in nature than for nonimpaired elders?

The untangling of relations among sensory loss, comorbidities and secondary conditions, activity limitations, and restrictions in participation pose significant public health challenges. ■

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#### Contributors

J.E. Crews planned the study, conducted the literature review, and wrote most of the article. V.A. Campbell planned the analytical design, conducted the analysis, and wrote portions of the article.

#### Human Participant Protection

No protocol was needed for this study. The National Center for Health Statistics' *National Health Interview Survey, 1994: Second Supplement on Aging*, a publicly available data set, contains no individual identifiers.

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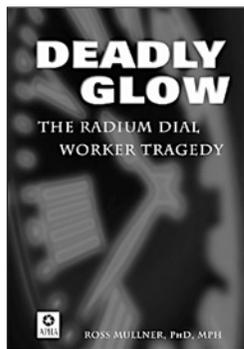
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# Self-Reported Changes in Drug and Alcohol Use After Becoming Homeless

Thomas P. O'Toole, MD, Jeanette L. Gibbon, MPH, Barbara H. Hanusa, PhD, Paul J. Freyder, MSW, Alicia M. Conde, MD, MPH, and Michael J. Fine, MD, MSc

Homelessness is associated with premature mortality and high levels of morbidity,<sup>1-3</sup> despite the fact that homeless persons utilize health care systems at very high rates.<sup>4-7</sup> Much of this high rate of use has been attributed to substance abuse,<sup>8,9</sup> which, in a study of homeless persons in Alameda County, California, was reported to be 8 times more prevalent among the homeless than among the general population.<sup>10</sup> Also in this study, more than half (52.4%) of homeless respondents had a current substance use disorder. Current drug disorders were more common among respondents who were younger and who had been homeless longer. Whereas in the general population low educational attainment, unemployment, and marital status are associated with substance use, homelessness and recent institutionalization have been identified as significant factors in substance use among homeless persons.<sup>11</sup>

However, we know much less about the relationship between homelessness and substance abuse than we do about the incidence or prevalence of substance abuse disorders among homeless persons. What effect does homelessness have on the amount of drugs and alcohol being consumed? How is a drug addiction supported in the context of the extreme poverty associated with being homeless? What are the individual and societal costs of addiction among the homeless? Models attempting to define the relationship between substance abuse and homelessness have noted a bidirectional relationship, with both social selection and social adaptation taking place.<sup>12</sup> Substance abuse has been linked indirectly to actual loss of housing but linked directly to a breakdown of social bonds,<sup>13</sup> whereas chronic homelessness has been associated with an earlier age at onset of drug and alcohol use disorders.<sup>14</sup> An appreciation of the dynamics and causative factors associated with homelessness is necessary if we are to develop better-informed public policies and medical and social interventions.

**Objectives.** We identified substance use patterns and factors associated with increased substance use after users become homeless.

**Methods.** We carried out a 2-city, community-based survey that used population-proportionate sampling of 91 sites with random selection at each site.

**Results.** Five hundred thirty-one adults were interviewed; 78.3% of them met *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* criteria for substance abuse or dependence. Most of those who met the criteria reported using drugs and alcohol less since they became homeless, commonly because they were in recovery. Factors independently associated with increased use were no health insurance (odds ratio [OR]=1.6; 95% confidence interval [CI]=1.02, 2.58), alcohol abuse or dependence (OR=3.5; 95% CI=1.85, 6.78), and selling plasma (OR=2.6; 95% CI=1.32, 5.14) or panhandling (OR=3.0; 95% CI=1.65, 5.55) to acquire drugs.

**Conclusions.** Becoming homeless plays a role in self-reported substance use. Multiservice treatment programs and tailored interventions for homeless persons are needed. (*Am J Public Health.* 2004;94:830-835)

In this article we present data from a 2-city, community-based study of urban homeless adults that describes the effects of self-reported trends and patterns of substance use on homeless status, means of acquiring drugs and supporting an addiction, and interactions with the criminal justice system. Our hypothesis in this study was that drug and alcohol use would increase once a person became homeless, reflecting the increased stresses and social isolation of being homeless and the role of substance abuse in causing homelessness.

## METHODS

We conducted a cross-sectional survey of homeless adults in Pittsburgh and Philadelphia, Pa, from April to August 1997. Selection was performed with probability-proportionate sampling of interview sites and random selection of interviewees at the each site.

### Study Population

Inclusion criteria were being 18 years of age or older and homeless (defined as being unsheltered or living in an emergency shelter, transitional housing unit, or "doubled-up" with

friends or family) for most of the previous 3 months. Individuals were excluded if they were incoherent, abusive, psychotic, or acutely intoxicated at the time of interview. Each participant received \$5 in cash or the equivalent in bus tokens and a listing of area health and social service providers after completing the interview.

### Survey Design

To capture the full spectrum of homeless persons, 91 interview sites (Pittsburgh: 39 sites; Philadelphia: 52 sites) were used for this study. Sites were selected on the basis of recommendations by homeless providers in each city and from listings compiled by the Pittsburgh Office of Hunger and Homeless Services and the Philadelphia Office of Emergency Sheltering Services. The 91 sites represented 69.5% of all sites identified. Sites were not used if permission to conduct interviews was not obtainable or if the site had too few (<7) clients. The sites were grouped as unsheltered enclaves (including abandoned buildings, cars, and outdoors) and congregate eating facilities (n=28), emergency shelters (n=36), and transitional housing or single-

room-occupancy dwellings ( $n=27$ ). Three to 5 sites within each group were selected every 2 weeks with probabilities proportional to size sampling based on previously enumerated site capacities to determine the frequency of site selection. Random sampling of individuals was then performed at each site.

### Subject Identification and Recruitment

Selection of interviewees at a site used 1 of 4 selection plans depending on the type of site and the number of people present at the time of the interview. When only 1 subject was encountered, that person was approached and screened for eligibility. If fewer than 7 people were at the site, the interviewer assigned each person a number from 1 to 6 and a die was tossed to determine which person was interviewed. For those sites with a sign-in list or at which a list could be created, the interviewers were given a randomly assigned number used to select the person from the list to screen. Finally, for sites with no sign-in list with 7 or more individuals present, the interviewers selected a fixed environmental marker (e.g. a doorway, bench, table, etc.) and counted people from that point, then used the same randomly assigned number to select the person for screening. Markers were typically a park bench for outdoor sites or a chair or couch for indoor sites. To ensure that each person was interviewed only once, a list of all previously interviewed participants (with social security numbers and birth dates) was distributed bimonthly to the interviewers.

### Survey Instrument

We used a version of the National Technical Center Telephone Substance Dependence Needs Assessment Questionnaire, modified for face-to-face interviews and with questions specific to homelessness added.<sup>15</sup> The survey included questions on demographic characteristics, past and current alcohol and drug use, self-reported medical and mental health comorbidities, prior substance abuse-related treatments, interactions with the criminal justice system, means of acquiring drugs, and a 19-item, Likert-scored assessment of current health and social service needs. All additions to the questionnaire either were used in our previous Homeless Health Utilization Survey,<sup>4</sup> a prior survey of homeless persons in Los An-

geles County, California, conducted by Robertson et al.,<sup>16</sup> or were pilot tested in sample interviews of homeless individuals before use. Determination of substance use disorders was based on *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition*<sup>17</sup> (*DSM-III-R*) diagnostic criteria for alcohol and drug dependency with software developed for the National Technical Center questionnaire.

### Data Collection

Interviews were conducted on-site in as private a setting as possible, in person and one-on-one, by 4 formerly homeless research assistants to facilitate a better acceptance of the survey and to create a more comfortable environment for respondents to truthfully answer questions. Each interviewer received extensive training before beginning the study as well as intermittently during the study to maintain consistency among interviews. All interviews were audiotaped, with 10% of each interviewer's tapes randomly selected for review to ensure data integrity. Weekly debriefing sessions were also conducted with interviewers in both cities to discuss problems and issues related to site selection, participant recruitment, or the survey instrument.

### Methods of Analysis

To provide a more inclusive assessment of need within this population, the unit of analysis in this study included both individuals with current substance abuse and individuals with substance dependence. Preliminary analyses identified no significant differences between persons with current abuse and persons with dependence. This combining of abuse and dependence categories to identify the cohort was also used in an earlier community-based study that examined substance abuse among homeless persons.<sup>10</sup>

Categorical data were compared with either a  $\chi^2$  test or the Fisher exact test. Continuous variables were compared with the Student *t* test. A *P* value of less than .05 on the basis of 2-sided tests was considered statistically significant. To identify independent risk factors for increased use of drugs or alcohol after becoming homeless, we analyzed demographic characteristics, reasons for homelessness, substance use patterns, and self-reported means of getting money with a logistic regression model for

each group of variables. Independent factors obtained in each group analysis were included in a global logistic regression model. All statistical analyses were conducted with SPSS version 10.0 for Windows (SPSS Inc, Chicago, Ill).

## RESULTS

A total of 531 persons, 267 in Pittsburgh and 264 in Philadelphia, were interviewed, representing a survey response rate of 93%.

### Demographics

As shown in Table 1, the majority of respondents were in their late 30s, African American, male, and single. Most had at least a high school diploma or equivalent, and more than three fourths had been sheltered or homeless (emergency shelter, transitional housing, or doubled-up with family or friend) for most of the previous 3 months. Almost 25% reported being veterans. Although the majority of respondents reported having been homeless for less than 12 months, almost 1 in 3 had been homeless for more than 3 years. Overall, 60.8% had health insurance, typically Medicaid coverage. Almost two thirds of the respondents reported having been diagnosed with 1 or more medical problems (hypertension: 25.0%; arthritis/musculoskeletal condition: 14.0%; respiratory disorder: 13.0%). Similarly, almost half reported that they had been diagnosed with 1 or more mental health problem (depression: 39.0%; anxiety disorder: 15.0%; posttraumatic stress disorder: 12.0%). No difference was found in age, gender, or sheltering arrangement among respondents in these 2 geographic areas. Significantly more African Americans were interviewed in Philadelphia than in Pittsburgh (87.1% vs 75.7%,  $P<.01$ ). More Pittsburgh homeless than Philadelphia homeless had at least a 12th-grade education (78.2% vs 61.8%,  $P<.01$ ), were working in some capacity (38.2% vs 25.0%,  $P<.01$ ), and reported being disabled (59.1% vs 46.2%,  $P=.01$ ).

### Substance Abuse/Dependence Patterns

Overall, 78.3% of respondents met *DSM-III-R* criteria for substance abuse or for dependence on alcohol, drugs, or a combination of alcohol and drugs. More Philadelphia homeless than Pittsburgh homeless screened

**TABLE 1—Demographics, Reasons for Homelessness, Self-Reported Comorbidities, and Substance Use Disorders Among Respondents in Pittsburgh and Philadelphia**

Characteristics	Percentage of Respondents		P
	Pittsburgh (n = 267, Mean Age = 40.3 y)	Philadelphia (n = 264, Mean Age = 39.1 y)	
<b>Demographics</b>			
Race: African American	75.7	87.1	<.01
Gender: male	78.3	81.8	.31
Education: ≥ 12th grade or general equivalency diploma	78.2	61.8	<.01
Marital status: single/divorced/widowed	97.4	94.4	.08
Veteran	27.3	21.2	.10
Health insurance: none	41.4	37.1	.31
Sheltering status (3 mo): unsheltered	24.1	23.5	.87
Duration of homelessness (mo)			
≤ 12	39.9	45.5	.19
13–36	32.0	26.9	.20
> 36	28.2	27.7	.90
<b>Reasons for homelessness (major reason on 5-point Likert scale)</b>			
No money	75.3	71.9	.37
No job	66.3	68.8	.53
Alcohol/drug use	50.0	67.3	<.01
Psychiatric problem	31.1	25.5	.15
Family crisis/domestic dispute	20.6	30.8	.01
<b>Self-reported comorbid conditions</b>			
Chronic medical conditions			
1 condition	24.7	30.3	.15
≥ 2 conditions	31.9	33.2	
Psychiatric conditions			
1 condition	22.1	20.5	.65
≥ 2 conditions	22.8	25.0	.55
Current <i>DSM-III-R</i> <sup>17</sup> substance abuse/dependence	73.8	83.0	.01

positive for substance abuse or dependence (83.0% vs 74.8%,  $P < .01$ ), with the difference predominantly resulting from higher rates of cocaine use. Alcohol, cocaine, and heroin were the most commonly reported substances of abuse, with alcohol being the most commonly abused substance both individually and in combination with other drugs. Almost half of all respondents met criteria for abuse or dependence of only 1 substance, whereas 31.7% abused combinations of 2 drugs, and 23.1% abused or were dependent on 3 or more substances (Table 2).

**Means of Acquiring Drugs and Legal Consequences**

When respondents were asked to select from a list of different means they had used to

be able to afford specific drugs (selling belongings, working for a dealer, diverting funds from daily sustenance, exchanging sex for drugs), responses revealed a consistent pattern (Table 3). Diverting funds from daily sustenance or from an entitlement (i.e., using rent or food money, selling or trading food stamps) was the most common practice, regardless of the drug in question (range: 46.6%–76.4%). This was followed by selling one’s belongings, working for a drug dealer in exchange for drugs, and stealing. Panhandling and begging for money was reported by almost half of those using heroin and cocaine but by fewer respondents using marijuana. Diverting child support money and exchanging sex for drugs were the least commonly reported means of acquiring drugs, although they were still

self-reported by a substantial minority of respondents (range: 26.2%–38.5%). Heroin users consistently reported using all of these means at higher rates than did cocaine users, whereas marijuana users reported engaging in them the least. There was no difference in reported rates for any behavior between cities.

Overall, 18.3% of respondents reported that they had been arrested for a crime in the past 12 months. Of those who had been arrested (n=96), almost two thirds reported being arrested once during that time period (63.4%), and 36.1% reported spending more than 30 days in jail during the previous 12 months. Reasons for arrest that were directly related to drug and alcohol use (disorderly conduct, threatening behavior, public drunkenness, possession of an illegal substance, possession with intent to sell, and driving under the influence) accounted for 87 (53.0%) of the 164 arrests. Arrests for prostitution, shoplifting, and robbery, which may be indirectly related to substance abuse, accounted for 38 arrests (23.2%). There was no difference between cities in either the overall number of individuals arrested or for the crimes committed, except for shoplifting (Pittsburgh 8.7% vs Philadelphia 33.3%,  $P < .01$ ) and possession of an illegal substance with intent to sell (Pittsburgh 2.2% vs Philadelphia 17.6%,  $P = .01$ ).

When respondents were asked to rate reasons for becoming homeless, 3 of 9 potential reasons were identified as “a major reason” by more than half of respondents: no money (73.4%), no job (67.4%), and alcohol or drug use (58.4%). Psychiatric problems were rated as a major problem by 28.2%, and family crisis/domestic dispute was a major reason for 25.6% of respondents. Significantly more homeless persons in Philadelphia than in Pittsburgh reported drug or alcohol use and family crises as major reasons (30.8% vs 20.6%;  $P = .01$ ), with no other differences noted between cities.

**Substance Use After Becoming Homeless**

As shown in Table 4, the majority of respondents with current substance abuse or dependence (69.5%) reported using less or the same amount of drugs and alcohol after becoming homeless compared with their use before becoming homeless. Individuals who

**TABLE 2—Substance Abuse/Dependence Patterns Among Current Users**

	Percentage of Respondents		P
	Pittsburgh	Philadelphia	
1 drug only	39.8	31.1	.04
Alcohol only	25.5	9.8	<.01
Cocaine only	9.0	14.8	.04
Heroin only	3.0	3.8	.61
2 drugs	22.4	27.3	.19
Cocaine + alcohol	13.5	22.3	.01
Alcohol + marijuana	4.5	1.5	.04
Heroin + cocaine	3.7	3.0	.65
3 drugs	11.6	24.6	<.01
Cocaine + marijuana + alcohol	8.6	11.0	.35
Heroin + cocaine + alcohol	1.1	4.5	.02
Heroin + cocaine + marijuana	0.4	1.5	.20
Heroin + marijuana + alcohol	0.7	1.1	.63

**TABLE 3—Self-Reported Methods for Obtaining Drugs**

Method	Percentage of Respondents		
	Marijuana (n = 133)	Cocaine (n = 267)	Heroin (n = 65)
Selling/trading food stamps	46.6	69.7	70.8
Selling drugs/working for a dealer	48.9	59.9	72.3
Using rent/food money	48.1	76.4	75.4
Selling belongings	37.6	68.2	72.3
Stealing	31.6	61.4	69.2
Panhandling/begging	22.6	37.4	49.2
Using child support money	13.5	26.2	38.5
Exchanging sex for drugs	0.0	28.5	33.9

reported more drug and alcohol use were significantly more likely to be nonveterans, to be without health insurance, to have been homeless longer than 12 months, and to have been arrested in the previous 12 months. They were also significantly more likely to report no money, no job, no entitlement assistance, and drugs and alcohol as major reasons for their homelessness. They were more likely to use alcohol or heroin and to report panhandling, stealing, or selling plasma to support their addiction. In the multiple logistic regression model, only no health insurance (odds ratio [OR]=1.6; 95% confidence interval [CI]=1.02, 2.58), alcohol abuse/dependence (OR=3.5; 95% CI=1.85, 6.78), panhandling (OR=3.0; 95% CI=1.65, 5.55), and selling plasma (OR=2.6; 95% CI=1.32, 5.14) were independently associated with using more

drugs or alcohol after becoming homeless. Significantly higher proportions of Pittsburgh homeless reported using more (33.0% vs 23.1%,  $P<.01$ ) or the same amount of alcohol (33.0% vs 19.4%,  $P<.01$ ) after becoming homeless compared with their Philadelphia counterparts, with no other differences noted.

For respondents reporting less use of drugs or alcohol, the most commonly cited reason for the decrease was that they were in recovery (50.6%), followed by not being able to afford the substance now that they were homeless (21.6%). For respondents who reported using more alcohol or drugs since becoming homeless, mental health issues (21.2%), typically self-reported anxiety or depression, were commonly cited reasons for each drug category. The “homeless environment” was cited as a reason for drinking more alcohol by

18.0% of Pittsburgh respondents and 2.4% of Philadelphia respondents ( $P=.02$ ).

**DISCUSSION**

The data presented here describe and contextualize the relationship between substance abuse and homelessness in 2 urban cities. As has been noted in previous studies, substance use is extremely prevalent among homeless persons and can be a major precipitant of homelessness.<sup>4,10,18</sup> However, the relationship between homelessness and substance abuse is also complex, with no clear cause or effect association uniformly identified in previous studies.<sup>12,13</sup> In our study, more than three fourths of the urban community-based sample met *DSM-III-R* criteria for substance abuse or dependence, and more than half reported that substance abuse played a major role in their becoming homeless. Our finding that 69.5% of respondents with a substance use disorder reported decreased or the same amount of use after they became homeless is noteworthy and somewhat surprising. It indicates that substance use among homeless persons is not a static condition, but rather one that is influenced by many variables, including cost, co-occurring mental illness, availability of treatment, and other features unique to homelessness. More respondents had reduced their cocaine and heroin use than their alcohol intake; for those individuals who did report a decline in substance use, a substantial proportion attributed the reduction to their being in recovery. For those who reported an increase in their substance use after they become homeless, the increase often was in response to self-reported mental health symptoms. This apparent self-medication highlights the co-occurrence of mental health issues with substance abuse among homeless persons<sup>19</sup> and the need for dual-diagnosis-specific and other integrated care approaches. Not surprisingly, increases in substance use after becoming homeless were noted more commonly with alcohol than with other substances, a finding perhaps related to cost or availability. Begging, panhandling, and selling plasma to support one’s addiction and not having health insurance were independently associated with increased substance use after becoming homeless. Whether these factors are causal or reflect

**TABLE 4—Differences Between Individuals Reporting More Drugs or Alcohol Use Upon Becoming Homeless and Those Reporting Less or the Same Amount of Drug and Alcohol Use**

Demographics	Less or Same Use (n=289)	More Use (n=127)	P	OR (95% CI)
Age	38.3 (±7.9)	40.2 (±9.3)	0.05	
Race: African American	86.8 (243)	83.7 (103)	0.42	
Gender: male	83.4 (241)	83.5 (106)	0.99	
Education: < 12 <sup>th</sup> grade	34.6 (100)	30.2 (38)	0.38	
Single/divorced/widowed	96.9 (280)	96.9 (123)	0.99	
Veteran	28 (81)	16.5 (21)	0.01	
Health Insurance: none	36.9 (106)	52.8 (67)	<0.01	1.6 (1.02, 2.58)
Homeless ≥ 12 months	37.4 (108)	50.4 (64)	0.01	1.4 (0.88, 2.25)
Unemployed	64.7 (187)	63.8 (81)	0.86	
Arrested in last 12 mo.	17.3 (50)	27.6 (35)	0.02	1.4 (0.82, 2.48)
Reasons for homeless				
No money	67.7 (195)	84.3 (107)	<0.01	
No job	62.2 (179)	81.9 (104)	<0.01	
Alcohol/drug use	64.1 (184)	78.7 (100)	<0.01	1.68 (0.98, 2.87)
Psychiatric problem	29.9 (86)	29.1 (37)	0.88	
Family crisis	27.1 (78)	29.1 (37)	0.67	
No general assistance	23.6 (68)	40.2 (51)	0.01	
No medical assistance	18.5 (53)	33.9 (43)	0.01	
Substance use:				
Alcohol	65.4 (189)	89.8 (114)	< 0.01	3.5 (1.85, 6.78)
Cocaine	59.9 (173)	60.6 (77)	0.88	
Heroin	17 (49)	9.4 (12)	0.05	
Marijuana	28.4 (82)	26.8 (34)	0.74	
Two or more drugs	54.3 (157)	63 (80)	0.88	
Means of support:				
Steady job	14.9 (43)	5.5 (7)	<0.01	
Odd jobs	31.1 (90)	42.5 (54)	0.03	
Social security	18 (52)	10.2 (13)	0.05	
General relief/welfare	36.7 (106)	43.3 (55)	0.20	
VA benefits	3.8 (11)	1.6 (2)	0.23	
Friends/family	21.1 (61)	29.1 (37)	0.08	
Begging/panhandling	8.7 (25)	29.9 (38)	< 0.01	3.0 (1.65, 5.55)
Hustling/stealing	13.8 (40)	30.7 (39)	< 0.01	2.6 (1.32, 5.14)
Selling plasma	7.2 (21)	22.8 (29)	< 0.01	

a consequence of increased substance use is not discernable from our data. However, these findings do indicate that specific interventions and accommodations may be needed to connect this subgroup of homeless persons with necessary and appropriate services.

Our data also describe many of the societal costs of homelessness and substance abuse, underscoring the importance of policies that address the immediate and basic needs of homeless persons and that assist individuals in escaping poverty. For the majority of respon-

dents, acquiring drugs after becoming homeless typically involved at least 1 illegal activity placing them and their families at significant risk. Although these self-reported responses are likely to have underreported criminal behavior, the proportion reporting an arrest within the past 12 months that was either directly or indirectly related to substance abuse and the criminal activities associated with acquiring drugs was substantial. The high percentage of individuals reporting that they diverted funds from food stamps, rent money,

and child support is frustrating but should be understood in context. Previous studies found that most arrests of homeless persons were for less severe offenses related to maintaining subsistence.<sup>20</sup> Other studies found that receipt of disability benefits was not associated with an increase in substance abuse but was associated with an improvement in quality of life.<sup>21,22</sup>

The most commonly reported reason for decreasing the use of drugs or alcohol in this survey was that the person was in recovery. None of the interviews occurred at substance abuse treatment facilities, and only 12.5% of individuals who reported the same or reduced use after becoming homeless were currently living in transitional housing settings in which substance abuse services might have been linked to their sheltering. Although homeless persons are receiving drug and alcohol treatment, they are still homeless despite their recovery efforts. This situation highlights the importance of linking substance abuse treatment for homeless persons to housing<sup>23</sup> and other wraparound service needs. This linking should include medical and mental health care, permanent housing, education assistance, or work readiness programs. Strategies for homeless persons need to include more outreach and on-site treatment collocated in emergency shelters, soup kitchens, and other congregate sites. Having health insurance was independently associated with using less drugs and alcohol and presumably plays an important role in treatment availability. Public policies that restrict health insurance eligibility among homeless persons or that make treatment difficult to receive even with coverage are likely to have a negative effect at both an individual and a societal level.

It is noteworthy that significant differences were observed between homeless persons in Pittsburgh and those in Philadelphia. Higher rates of substance use were found in Philadelphia, and more Philadelphia homeless persons identified drug and alcohol use as a major cause of their homelessness. Pittsburgh homeless persons more often reported using alcohol and also using alcohol more after becoming homeless. We suspect that some of the differences, especially in cocaine use, may be related to the relative proximity of Philadelphia to other eastern cities and to a seaport where access to the drug may be easier and costs lower. Many of the demographic

differences likely reflect general population differences between the 2 cities. It is also important to note that at the time of this survey, Philadelphia had a central processing system for homeless persons seeking emergency shelter and thus was more likely to have on-site counselors and interventionists in their shelter facilities. The availability of this system may have contributed to the greater self-reporting of need and greater insight into the association between substance use and homelessness found among Philadelphia respondents.

Our study had several limitations. We relied on self-reported data from a cross-sectional survey. Given the sensitive nature of some of the questions, underreporting was likely to have affected some results. Self-reported mental health conditions were likely underreported because of the social stigma associated with many mental health conditions and because we had asked only for conditions diagnosed by a health professional, which assumes access to that level of care. Questions regarding substance use patterns may also reflect biased self-reporting, because respondents may have felt compelled to report reduced use, particularly if they were interviewed in a setting in which reduced use was promoted. Using formerly homeless community health workers as interviewers minimized some of this bias by facilitating a more trusting environment for collecting information. We did not objectively measure or quantify actual substance use changes, which are subject to both recall and reporting bias. The use of standardized *DSM-III-R* criteria to determine current abuse and dependence provided some objectivity in estimating the prevalence in this sample. Our sampling strategy was deliberately intended to capture a broad spectrum of urban homeless persons and to reflect the heterogeneity of the population. Although the use of 91 sites does reflect a methodological rigor, it is possible that the overrepresentation of larger sites may have created a selection bias. Finally, the sample was from 2 urban mid-Atlantic cities. Significant differences noted between the 2 samples underscore a potential for regional variability to be accounted for when making generalizations.

In summary, these data provide a more in-depth description of the role of substance abuse in homelessness. These findings support the need to make substance abuse treatment

more available and linked to the broader objectives of helping individuals achieve stable housing. ■

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### Contributors

T.P. O'Toole designed and supervised the study, supervised the data analysis, and wrote the article. J.L. Gibbon supervised data collection and contributed to the statistical analysis. B.H. Hanusa assisted in the study design and statistical analysis. M.J. Fine assisted in the study design, data analysis, and editing of the article. P.J. Freyder assisted in the study design and data interpretation. A.M. Conde assisted in the statistical analyses and data interpretation.

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### Human Participant Protection

This study received approval from the University of Pittsburgh psychosocial study review board and the University of Pennsylvania institutional review board. All participants provided informed consent.

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# The Limited Relevance of Drug Policy: Cannabis in Amsterdam and in San Francisco

Craig Reinerman, PhD, Peter D.A. Cohen, PhD, and Hendrien L. Kaal, PhD

There is a trend among Western democracies toward liberalization of cannabis laws. (Cannabis includes both marijuana and hashish.) In 1976, the Netherlands adopted de facto decriminalization. Under Dutch law, possession remains a crime, but the national policy of the Ministry of Justice is to not enforce that law. After 1980, a system of “coffee shops” evolved in which the purchase of small quantities of cannabis by adults was informally tolerated and was then formally permitted in shops that were licensed.<sup>1–3</sup> During the 1990s, Switzerland, Germany, Spain, Belgium, and Italy shifted their drug policies in the Dutch direction. Portugal decriminalized cannabis in 2001, and England similarly reclassified cannabis in 2004. Canada and New Zealand are currently considering cannabis decriminalization. These shifts constitute the first steps away from the dominant drug policy paradigm advocated by the United States, which is punishment-based prohibition.<sup>4–6</sup>

Moving in the opposite direction, the United States has stiffened criminal penalties for drug offenses and has increased arrests for cannabis offenses. Since 1996, voters in 8 states and the District of Columbia have passed medical-marijuana initiatives, but the federal government has resisted implementation. In 2001, 723 627 people were arrested for marijuana offenses.<sup>7</sup> In 2002, the Drug Enforcement Administration began raiding medical-marijuana organizations,<sup>8</sup> and the White House Office of National Drug Control Policy launched a campaign against marijuana.<sup>9,10</sup>

Such policies are designed to deter use. The core empirical claim made by criminalization proponents is that, absent the threat of punishment, the prevalence, frequency, and quantity of cannabis use will increase and will threaten public health.<sup>11–16</sup> The question of whether deterring use enhances public health was beyond the scope of our study, but we

**Objectives.** We tested the premise that punishment for cannabis use deters use and thereby benefits public health.

**Methods.** We compared representative samples of experienced cannabis users in similar cities with opposing cannabis policies—Amsterdam, the Netherlands (decriminalization), and San Francisco, Calif (criminalization). We compared age at onset, regular and maximum use, frequency and quantity of use over time, intensity and duration of intoxication, career use patterns, and other drug use.

**Results.** With the exception of higher drug use in San Francisco, we found strong similarities across both cities. We found no evidence to support claims that criminalization reduces use or that decriminalization increases use.

**Conclusions.** Drug policies may have less impact on cannabis use than is currently thought. (*Am J Public Health.* 2004;94:836–842)

did examine the proposition that drug policies affect user behavior and deter use. It is possible that the causal arrow points the other way—that user behavior affects laws and policies, which has been the case with alcohol policies in some countries.<sup>17</sup> However, the Marijuana Tax Act of 1937, which first criminalized cannabis, predated widespread cannabis use in the United States and had clear political origins.<sup>18–21</sup> In the Netherlands, de facto decriminalization of cannabis was first forged in the late 1960s, when use was spreading among the youth counterculture. But Dutch policymakers decided that cannabis use was unlikely to lead to deeper deviance and that criminalization could lead to greater harm to users than the drug itself.<sup>3</sup> In neither country, then, was user behavior the effective cause of laws or policies.

The presumed effects of cannabis policies have been explored by those who are critical of criminalization in the United States<sup>22</sup> and by those who are skeptical of Dutch decriminalization.<sup>23</sup> However, until now there have been no rigorously comparative studies of user behavior designed to assess whether criminalization constrains use or whether decriminalization increases it. Our study compared the career use patterns of representative samples of experienced cannabis users in 2 cities with many similarities but with differ-

ent drug-control regimes—Amsterdam, the Netherlands (decriminalization), and San Francisco, Calif (criminalization).

San Francisco was selected as the US comparison city not because it is representative of the United States but because it is the US city most comparable to Amsterdam. Both cities are large, highly urbanized port cities with diverse populations of slightly more than 700 000. They are financial and entertainment hubs for larger regional conurbations, and they have long been perceived within their home countries as cosmopolitan, politically liberal, and culturally tolerant.

Law enforcement officials in San Francisco are not as zealous about enforcing marijuana laws as law enforcement officials are in most other US cities. Nonetheless, San Francisco is embedded in the drug policy context of criminalization, which is a markedly different drug policy context than that of Amsterdam. Buying and selling cannabis are permitted in Amsterdam in 288 licensed “coffee shops,”<sup>24</sup> and public use is permitted, whereas in San Francisco, buying, selling, and public use of marijuana remain criminal offenses. In Amsterdam, there is neither proactive nor reactive policing of use or low-level sales, although police do enforce regulations against coffee shops’ advertising, selling to minors, and creating public nuisances.

In San Francisco, there is strong proactive and reactive policing of sales, and there is moderate reactive policing of use.

These differences in drug policy context are palpable to users. San Francisco students are suspended from schools and are placed in treatment for marijuana use. San Francisco users risk citations, fines, and arrests if they are detected buying, possessing, or using marijuana. In Amsterdam, users face none of these risks. The use and sale of other illicit drugs sometimes used by cannabis users is proactively policed in San Francisco. In Amsterdam, police occasionally engage in reactive policing of complaints about open use or sale of other drugs, but they do not proactively patrol in search of these offenses.

## METHODS

We required not merely a random sample of cannabis users but a random sample of users who had enough experience (defined as at least 25 episodes of use during their lifetimes) to answer questions about career use patterns. In Amsterdam, recruitment of users began as part of a drug-use prevalence survey of the general population. This survey was administered to a random sample that was obtained from Amsterdam's Municipal Population Registry. The overall response rate was 50.2%, which yielded a sample of 4364.<sup>25</sup> (The response rate was slightly below the 55% response rate of a 1990 iteration of the survey. Sampling details and an extensive response/nonresponse study can be found in Sandwijk et al.<sup>24</sup> or at <http://www.cedro-uva.org/lib>.) Comparisons of responders with nonresponders and with known city demographic data indicated no need for weighting. All respondents who reported having used cannabis at least 25 times ( $n=535$ ; 12.3%) were asked to participate in an in-depth interview about their cannabis use. Of these 535 experienced users, 216 (40.5%) were interviewed in 1996.<sup>26</sup>

This modest response rate necessitated a check of representativeness. We compared the 216 users who responded with the 319 who did not on 12 demographic and drug-use prevalence variables. Respondents had slightly higher levels of formal education and slightly higher past-year prevalence of cannabis

use,<sup>26,27</sup> but otherwise, they showed no differences compared with nonrespondents and thus were reasonably representative of experienced cannabis users in the general population. Homeless and institutionalized persons were not interviewed for either survey.

Beginning in 1997, the Amsterdam survey of experienced cannabis users was replicated in San Francisco, where there is no population registry. To remain consistent with Amsterdam, we first drew an area probability sample by randomly selecting census tracts, blocks, buildings, households, and adults within households. We administered a brief prevalence survey containing demographic and drug-use prevalence questions. Unlike the Amsterdam prevalence survey, which was an extensive study in its own right, the brief prevalence survey in San Francisco was principally designed to generate a random representative sample of experienced cannabis users.

The overall response rate of the San Francisco prevalence survey was 52.7%, which yielded a sample of 891.<sup>28</sup> Of these respondents, 349 reported that they had used cannabis 25 or more times (39.2% of the population sample and 3 times the prevalence found in the Amsterdam sample) and were asked to participate in the in-depth interview; 266 (76.2%) respondents were ultimately interviewed in-depth about their career use patterns. As a check on their representativeness, respondents were compared with nonrespondents on 10 demographic and drug-use prevalence variables. No statistically significant differences were found.

The Dutch questionnaire was translated for use in San Francisco. Non-English-speaking Asian Americans were excluded because of the prohibitive costs of translating instruments and training interviewers in the many Chinese and other Asian languages found in San Francisco. This exclusion was not consequential, because national prevalence studies show that illicit drug use among Asian Americans is the lowest of any ethnic group.<sup>29</sup> Also, non-English speakers are mostly elderly and are thus least likely to be cannabis users. However, the instruments were translated into Spanish, and bilingual interviewers conducted interviews when necessary. Homeless and institutionalized persons were not interviewed.

## RESULTS

### Age at Onset, First Regular Use, and Maximum Use

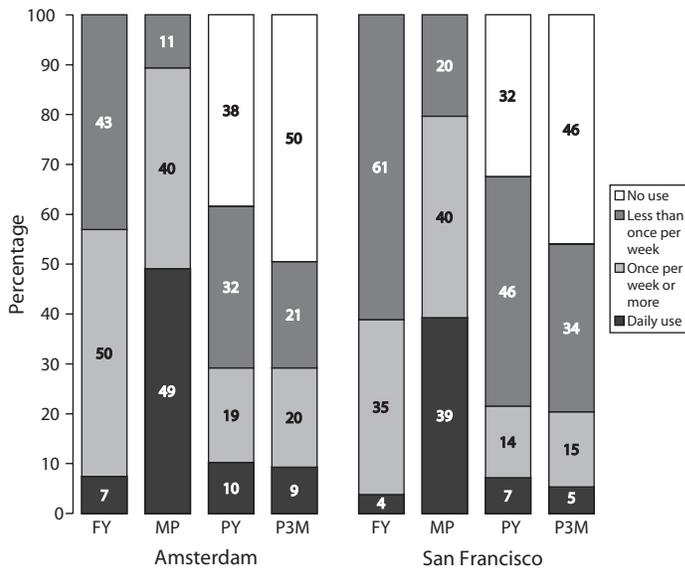
The mean age at onset of cannabis use was nearly identical in both cities: 16.95 years in Amsterdam and 16.43 years in San Francisco. The mean age at which respondents commenced regular use ( $\geq$  once per month) also was nearly identical: 19.11 years in Amsterdam and 18.81 years in San Francisco. The mean age at which respondents in both cities began their periods of maximum use was about 2 years after they began regular use: 21.46 years in Amsterdam and 21.98 years in San Francisco. Clear majorities in both cities reported periods of maximum use of 3 years or less.

### Cannabis Use Patterns Over Time

We asked about the frequency and the quantity of use and the intensity and the duration of intoxication. To assess how these dimensions of use may have changed over time, we asked about each for 4 periods: first year of regular use ( $\geq$  once per month), maximum-use period, past year (12 months before the interview), and past 3 months (3 months before the interview).

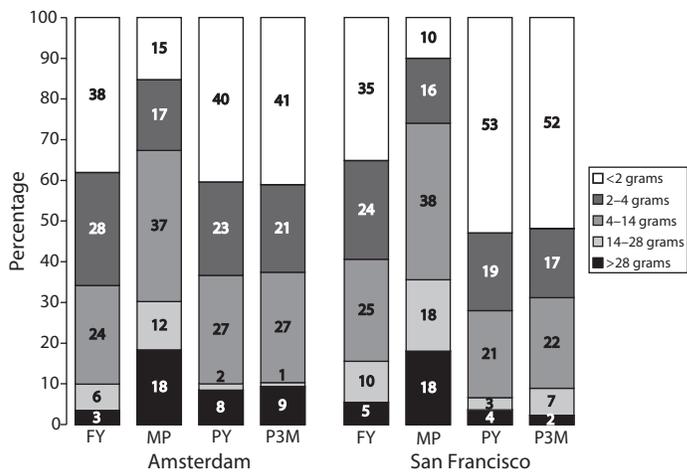
*Frequency of use.* Figure 1 shows the frequency of reported marijuana use for these 4 periods; the overall pattern is similar across both cities. During first year of regular use, strong majorities reported use of cannabis once per week or less, whereas small percentages reported daily use. Frequency increased during the period of maximum use but declined sharply thereafter. Amsterdam respondents reported more frequent use than did San Francisco respondents during their first year of regular use ( $t=4.019$ ;  $df=479$ ;  $P=.000$ ) and during their period of maximum use ( $t=2.979$ ;  $df=479$ ;  $I=.003$ ). When the maximum-use period was compared with the past year, daily use declined from 49% to 10% in Amsterdam and from 39% to 7% in San Francisco. This decline was even greater for the past 3 months.

The basic trajectory of frequency of use across careers was parallel in both cities. Most users reported a maximum-use period of 2 to 3 years, after which the vast majority sharply reduced their frequency of use or stopped al-



Note. FY = first year of regular use ( $\geq$  once per month); MP = maximum-use period; PY = past year; P3M = past 3 months.  
<sup>a</sup>All respondents.

FIGURE 1—Frequency of cannabis use for 4 periods, by city (%).<sup>a</sup>



Note. FY = first year of regular use ( $\geq$  once per month); MP = maximum-use period; PY = last year; P3M = past 3 months.  
<sup>a</sup>Respondents who still used at time of survey, for past year and past 3 months.

FIGURE 2—Average quantity of cannabis used per month (%).<sup>a</sup>

together. Roughly three fourths of the respondents in each city reported that they had used cannabis less than once per week or not at all in the year before the interview.

**Quantity of use.** Figure 2 shows that in the first year of regular use, few respondents in either city consumed large quantities of can-

nabis. Only 3% in Amsterdam and 5% in San Francisco used 28 grams (approximately 1 ounce) during an average month. Amsterdam respondents used significantly smaller quantities than did San Francisco respondents during this period. When the 2 smallest categories were combined, two thirds in Amsterdam

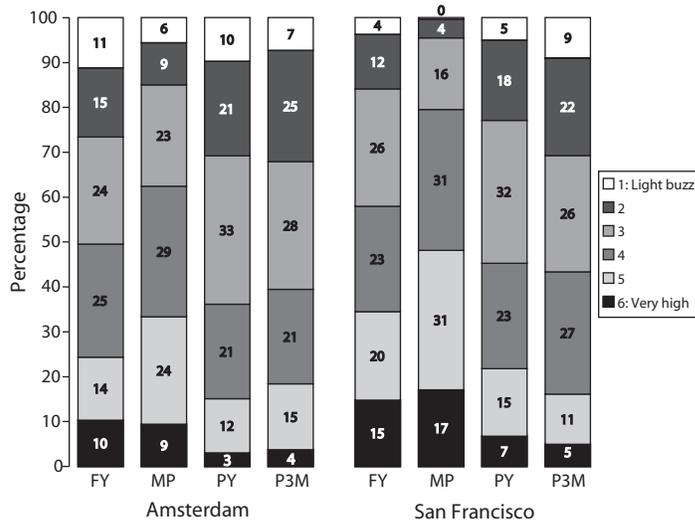
(66%) and slightly less in San Francisco (59%) were found to have consumed 4 or fewer grams per month during their first year of regular use. More than one third used less than 2 grams per month during their first year of regular use—38% in Amsterdam and 35% in San Francisco.

Quantities consumed during maximum-use periods were larger and very similar across the cities. About two thirds of respondents consumed an average of 14 or fewer grams per month—69% in Amsterdam and 64% in San Francisco. Less than 1 in 5 respondents in each city (18%) consumed an average of 28 grams per month or more during their maximum-use periods.

During the year before the interview, consumption among those who still used cannabis declined sharply. Clear majorities used 4 or fewer grams per month, although this proportion was smaller in Amsterdam (63%) than in San Francisco (72%) ( $t = 2.207$ ;  $df = 297$ ;  $P = .028$ ). About 1 in 3 respondents in each city reported no use. Overall, the patterns were parallel in both cities; quantities used increased from first regular use through maximum use but then quantities used declined steadily or use ceased altogether over the course of the respondents' careers.

**Intensity of intoxication.** Respondents were asked to estimate "how high or how stoned you generally got" when they consumed cannabis. Some recalled this occurrence with greater consistency than did others, but all of them were able to make basic ordinal distinctions between more- and less-intense highs. To increase reliability of respondents' estimates, we displayed a 6-point scale ranging from "light buzz" (1) to "very high" (6) and asked them to select the number that best summarized their highs during each period.

Figure 3 shows that respondents in both cities generally increased the intensity of their highs during periods of maximum use but moderated their highs thereafter (past-year and past-month figures exclude those who had quit). Amsterdam respondents were significantly more likely than San Francisco respondents to report milder intoxication during the first year of regular use and during maximum-use periods: mean scores for the first year were 3.5 in Amsterdam and 3.9 in San



Note. FY = first year of regular use ( $\geq$  once per month); MP = maximum-use period; PY = past year; P3M = past 3 months.  
<sup>a</sup> Respondents who still used at time of survey, for past year and past 3 months.

**FIGURE 3—Intensity of intoxication during typical occasion of cannabis use (%).<sup>a</sup>**

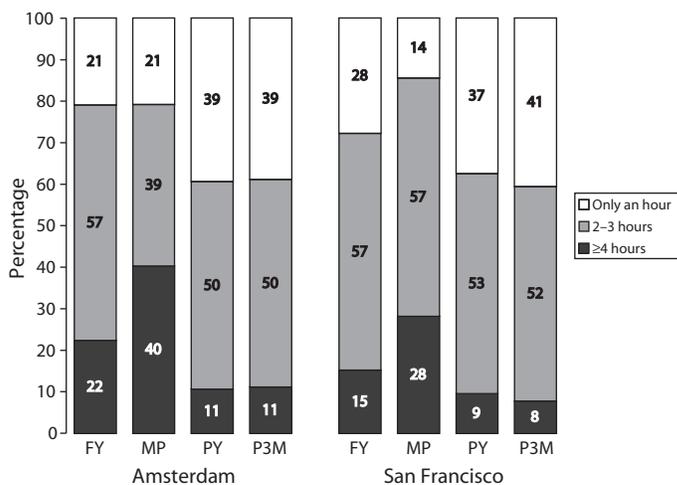
San Francisco ( $t=-3.180$ ;  $df=476$ ;  $P=.002$ ), and these scores rose for maximum-use periods to 3.9 and 4.4, respectively ( $t=-4.932$ ,  $df=413$ ;  $P=.000$ ).

The same pattern was found for the more recent periods, although the mean scores declined. The proportion of respondents who chose 6 (very high) remained small and was

between 3% and 7% in both cities. For highs experienced during the past year, Amsterdam respondents were again more likely to report milder intoxication ( $t=-2.233$ ;  $df=310$ ;  $P=.026$ ). For the past-3-month periods, majorities in both cities reported milder highs of 1 to 3 on the 6-point scale. In short, respondents in both cities reported

less intoxication with use over the course of their careers.

*Duration of intoxication.* We also asked “about how long” respondents were high during a typical occasion of cannabis use. Reported durations were correlated with frequency and with quantity but were not a function of frequency and quantity alone. Here, too, we found a tendency toward moderation over the course of users’ careers in both cities. Figure 4 shows that Amsterdam respondents reported highs of somewhat longer duration than reported by respondents in San Francisco during the first year of regular use ( $t=2.329$ ;  $df=476$ ;  $P=.020$ ). (One reviewer noted a divergence between San Francisco respondents, who reported more intense highs during 3 of the 4 periods, and Amsterdam respondents, who reported highs of longer duration during 1 period. Because we found no reason to suspect that either sample played up or played down their responses to any of the questions, this divergence may indicate culture-specific consumption styles or cultural grammars of intoxication.<sup>30,31</sup>) However, during the other 3 time periods there were no significant differences: in each city, a clear majority of users regulated their ingestion so that highs lasted 2 to 3 hours or less. Substantial minorities in each city reported being high for 4 or more hours during maximum-use periods, but these proportions dropped sharply after those periods. Of those who used cannabis during the 3 months before the interview, 89% in Amsterdam and 93% in San Francisco reported being high for 2 to 3 hours or less.



Note. FY = first year of regular use ( $\geq$  once per month); MP = maximum-use period; PY = past year; P3M = past 3 months.  
<sup>a</sup> Respondents who still used at time of survey, for past year and past 3 months.

**FIGURE 4—Duration of high during a typical occasion of cannabis use (%).<sup>a</sup>**

**Overall Career Use Patterns**

We also asked respondents to characterize their overall career use patterns. We presented a typology of trajectories<sup>32</sup> and asked them to identify the 1 that “best describes” their cannabis use over time (Table 1).

Two career use patterns were dominant in both cities. Pattern 4—gradual increased use followed by sustained decline—was the most common (49.4% of the combined sample). The second most common was Pattern 6—wide variation over time (24.4% of the combined sample). Patterns 1, 2, 3, and 5 were each selected by only 6% to 8% of the com-

**TABLE 1—Trajectories of Overall Career Use**

Pattern	Amsterdam, No. (%)	San Francisco, No. (%)
1: declining	17 (7.9)	18 (6.8)
2: escalating	13 (6.0)	17 (6.4)
3: stable	24 (11.1)	5 (1.9)
4: increase/ decline	104 (48.1)	133 (50.4)
5: intermittent	7 (3.2)	25 (9.5)
6: variable	51 (23.6)	66 (25.0)
Total	216 (100.0)	264 (100.0)

Note.  $\chi^2 = 24.047$ ;  $df = 5$ ;  $P = .000$ . Pattern names listed as shown to respondents.

bined sample. Pattern 3—stable use from the beginning onward—was selected significantly more often by Amsterdam respondents (11.1%) than by San Francisco respondents (1.9%), whereas Pattern 5—intermittent use (many starts and stops over time)—was selected significantly more often by San Francisco respondents (9.5%) than by Amsterdam respondents (3.2%).

These findings are consistent with findings on frequency and quantity of use and intensity and duration of intoxication, and they have important public health implications. Claims that cannabis produces addiction or dependence<sup>13–15</sup> lead one to expect that many experienced users would report Pattern 2—escalation of use over time. But this pattern was reported by only 6% in both cities, which means that 94% of respondents had overall career use patterns that did not entail escalation across careers.

### Other Illicit Drug Use

Another important question about the effects of drug policies concerns the use of other illicit drugs. The “separation of markets,” in which lawfully regulated cannabis distribution reduces the likelihood that people seeking cannabis will be drawn into deviant subcultures where “hard drugs” also are sold is one public health objective of Dutch decriminalization.<sup>1–3</sup> The reduction of cannabis use and thereby the reduction of the extent to which it serves as a “gateway” to “harder” drugs is one public health objective of US criminalization.<sup>11,12,14,16</sup>

**TABLE 2—Prevalence of Other Illicit Drug Use, Lifetime and During the Past 3 Months**

	Amsterdam (n = 216)		San Francisco (n = 264)		Significance $\chi^2$	
	LTP	P3MP	LTP	P3MP	LTP	P3MP
Cocaine	48.1	9.3	73.2	7.5	*	NS
Crack	3.7	0.5	18.1	1.1	*	<sup>a</sup>
Amphetamines	37.5	1.9	60.4	4.5	*	NS
Ecstasy	25.5	9.3	40.0	6.4	*	NS
Opiates	21.8	0.5	35.5	2.7	*	<sup>a</sup>

Note. LTP = lifetime period; P3MP = past 3 months; NS = not significant.

<sup>a</sup>Too few cases in cells to compute statistical test.

\* $P < .001$ .

Users who had ingested cannabis 25 times or more during their lifetimes were far more prevalent in San Francisco than in Amsterdam, and the same was true for users of other illicit drugs. Table 2 shows a significantly lower lifetime prevalence of other illicit drug use in Amsterdam than in San Francisco. During the 3 months before the interview, prevalence of crack and opiate use also were significantly higher in San Francisco, but cocaine, amphetamine, and ecstasy use were not significantly different. Thus, rates of discontinuation—the decline from lifetime prevalence to prevalence during the past 3 months—were somewhat higher in San Francisco for cocaine, amphetamine, and ecstasy; however, rates of discontinuation were high (64%–98%) for all drugs in both cities.

### DISCUSSION

Proponents of criminalization attribute to their preferred drug-control regime a special power to affect user behavior. Our findings cast doubt on such attributions. Despite widespread lawful availability of cannabis in Amsterdam, there were no differences between the 2 cities in age at onset of use, age at first regular use, or age at the start of maximum use. Either availability in San Francisco is equivalent to that in Amsterdam despite policy differences, or availability per se does not strongly influence onset or other career phases.

We also found consistent similarities in patterns of career use across the different policy contexts. Although a few significant differences were found in some dimensions of use

during some career phases, the basic trajectory was the same in both cities on all dimensions of use: increasing use until a limited period of maximum use, followed by a sustained decrease in use over time or by cessation. It is significant, from a public health perspective, that clear majorities of experienced users in both cities never used daily or used large amounts even during their peak periods, and that use declined after those peak periods. Furthermore, both samples reported similar steady declines in degree and duration of intoxication. Only 6% in each city reported escalation of use over time.

We expected differences in drug policies to affect the duration of cannabis-use careers and the rates of cessation. Criminalization is designed to decrease availability, discourage use, and provide incentives to quit. Decriminalization is said to increase availability, encourage use, and provide disincentives to quit. Thus, we expected longer careers and fewer quitters in Amsterdam, but our findings did not support these expectations. Cannabis careers ranged from 1 to 38 years, and 95% of respondents in both cities reported careers of 3 years or longer. The mean career length was slightly greater in San Francisco (15 years) than in Amsterdam (12 years), but this finding was mostly because of the somewhat higher mean age in the San Francisco sample (34 years vs 31 years). Similarly, nearly identical proportions of respondents in each city had quit by the time they were interviewed—33.8% in Amsterdam and 34.3% in San Francisco.

If drug policies are a potent influence on user behavior, there should not be such

strong similarities across such different drug control regimes. Our findings do not support claims that criminalization reduces cannabis use and that decriminalization increases cannabis use. Moreover, Dutch decriminalization does not appear to be associated with greater use of other illicit drugs relative to drug use in San Francisco, nor does criminalization in San Francisco appear to be associated with less use of other illicit drugs relative to their use in Amsterdam. Indeed, to judge from the lifetime prevalence of other illicit drug use, the reverse may be the case.

Our study has limitations and should be replicated in other cities over longer periods. While our findings share the limitations of all self-report studies (e.g., vague or selective memory, over- or understatement of fact), we attempted to minimize these limitations by means of carefully worded questions, extensive pretesting, and use of multiple measures. The questionnaire is available under *questionnaire* at <http://www.cedro-uva.org/lib/cohen.canasd.html>. Our comparable samples and measures helped isolate the effects of drug policies, but “all else” is not necessarily “equal.” Cultural and social conditions in the United States are different from in the Netherlands; therefore, cannabis use might increase if the United States were to adopt a Dutch approach. Further studies that examine prevalence before and after policy shifts would be illuminating, although previous studies of the impact of marijuana decriminalization among 11 US states during the 1970s found no increases.<sup>33–36</sup>

One hypothesis for future research is that with a widely used drug like cannabis, the informal social controls that users develop as part of their culture<sup>30,31,37–39</sup> have more powerful regulatory effects on their behavior than do formal social controls such as drug policies. This possibility emerged from responses to questions about the circumstances respondents found appropriate for cannabis use. In both cities, relaxation was the most common purpose of use, and majorities from both cities reported that they typically used cannabis with friends and at social gatherings. Majorities in both cities most often mentioned work or study as situations in which use was inappropriate. In both cities, 69% reported negative emotional states as unsuitable for

cannabis use, and 80% reported having advised novices about the virtues of moderation.

## CONCLUSIONS

These data suggest that most experienced users organize their use according to their own subcultural etiquette—norms and rules about when, where, why, with whom, and how to use—and less to laws or policies. When experienced users abide by such etiquette, they appear to regulate their cannabis use so as to minimize the risk that it will interfere with normal social functioning. This pattern suggests that if formal drug policies are based on the folk (informal) drug policies users themselves already practice, drug policies may achieve greater relevance. ■

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### Contributors

C. Reinerman assisted in conceiving the study and analyzing the data. H.L. Kaal composed the figures and the tables that form the core of the data analysis. P.D.A. Cohen proposed the study, led its conceptualization, designed and supervised the data analysis, and assisted with writing the article.

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### Human Participant Protection

This protocol was approved by all relevant institutional review boards and funding agencies.

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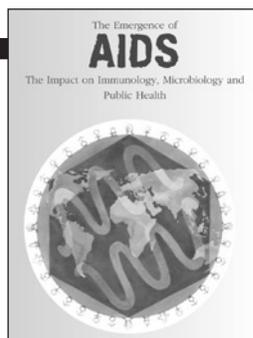
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# Draw the Line/Respect the Line: A Randomized Trial of a Middle School Intervention to Reduce Sexual Risk Behaviors

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Sexually transmitted diseases (STDs) (including HIV) and pregnancy remain serious problems for youths in the United States. According to the Office of National AIDS Policy,<sup>1</sup> young people in the United States between the ages of 13 and 24 years are estimated to be contracting HIV at a rate of 2 per hour, and half of all new HIV infections occur among persons younger than 25 years. Further, roughly 1 in 4 sexually experienced adolescents aged 13 to 19 years acquires an STD each year.<sup>1,2</sup> Finally, even with recent declines, the United States still has the highest teen pregnancy and birth rates among comparable industrialized nations.<sup>3,4</sup> Unfortunately, many consequences of unprotected sexual intercourse are more common among some subgroups of youths (e.g., African American and Latino) than others. For example, African American and Latino youths are disproportionately affected by HIV and AIDS,<sup>1</sup> and Latino adolescents aged 15 to 19 years currently have the highest birth rate of all racial/ethnic groups.<sup>5</sup>

Several prevention programs have been shown to reduce adolescent sexual risk behaviors.<sup>6</sup> Many of these studies have been conducted in high school settings<sup>6–11</sup> or with high school youths in nonschool settings.<sup>12,13</sup> It is important to target younger youths with prevention messages before they begin having risky sexual intercourse so that programs can help individuals delay sexual intercourse or avoid unprotected sexual intercourse.<sup>14</sup> Fortunately, most young people attend school,<sup>15</sup> which provides an efficient mechanism to reach them with effective prevention programs. To date, however, there are no published randomized trials of school-based HIV, other STD, and pregnancy prevention programs in middle schools with significant positive effects on behavior.<sup>16–19</sup> Studies with quasi-experimental designs have found some positive effects.<sup>20,21</sup> Addi-

**Objectives.** This study evaluated the long-term effectiveness of Draw the Line/Respect the Line, a theoretically based curriculum designed to reduce sexual risk behaviors among middle school adolescents.

**Methods.** The randomized controlled trial involved 19 schools in northern California. A cohort of 2829 sixth graders was tracked for 36 months.

**Results.** The intervention delayed sexual initiation among boys, but not girls. Boys in the intervention condition also exhibited significantly greater knowledge than control students, perceived fewer peer norms supporting sexual intercourse, had more positive attitudes toward *not* having sex, had stronger sexual limits, and were less likely to be in situations that could lead to sexual behaviors. Psychosocial effects for girls were limited.

**Conclusions.** The program was effective for boys, but not for girls. (*Am J Public Health.* 2004;94:843–851)

tionally, randomized trials of non-school-based programs have found effects.<sup>22,23</sup>

Given the significant consequences of unprotected sexual intercourse for adolescents, and the need for more program options at the middle school level, we developed Draw the Line/Respect the Line, an innovative theory-based program for middle school youths.

Draw the Line/Respect the Line is a 3-year, school-based HIV, other STD, and pregnancy prevention program for youths in sixth, seventh, and eighth grades. The primary aim of Draw the Line/Respect the Line is to reduce the number of students who initiate or have sexual intercourse and to increase condom use among those students who do have sexual intercourse. In addition, the program was designed to affect mediating variables (e.g., attitudes, perceived norms) drawn from our theoretical models.

This article presents the results of a randomized controlled trial undertaken to assess the impact of Draw the Line/Respect the Line. It also examines the relation between psychosocial variables and selected behavioral outcomes. The reported data are from a cohort of predominantly Latino sixth-grade students who were followed for 36 months.

## METHODS

### Study Design

The Draw the Line/Respect the Line intervention was implemented from spring 1997 to spring 1999. The study featured a randomized controlled trial involving 19 ethnically diverse public middle schools (grades 6 to 8) drawn from 3 small- to mid-sized school districts (6 to 8 schools per district) in an urban area of northern California. The 3 districts were selected because they served diverse populations (ethnically and in terms of socioeconomic status): at least 30% or more of the students in the schools within these districts were Hispanic. The districts also were in close proximity to the investigators. All schools within each of the 3 districts agreed to take part. A fourth district (representing 5 schools) was approached for study participation but declined because of concerns over surveying young students regarding their sexual behaviors.

Ten schools were randomly assigned to receive the Draw the Line program; the remaining schools continued with usual classroom activities regarding HIV, other STD, and pregnancy prevention, and these activities were dictated by the schools. We used a restricted randomization process involving

multiple steps. Schools within each district were initially partitioned into matched sets. Then 2 matched groups were formed, each consisting of 1 school set from each district. Finally, these 2 matched groups were randomized to the intervention or control condition. To facilitate the matching process, we used a principal component analysis of 9 school-level variables (e.g., ethnic composition, standardized test scores, socioeconomic status); this produced 4 principal component scores, and these were summed. This composite score, a school district identifier, and sixth-grade enrollment guided the creation of the school sets and groups. The equivalence of the final school sets and study groups was assessed by comparing profiles of the ethnic composition, test scores, socioeconomic status, and enrollment.

### Intervention

The Draw the Line/Respect the Line intervention was a 20-session curriculum based on social cognitive theory<sup>24</sup> and social inoculation theory<sup>25</sup> that assisted students in developing their personal sexual limits and practicing the skills needed to maintain those limits even when they are challenged. The curriculum was designed for use in sixth-, seventh-, and eighth-grade classrooms and was designed to have a cumulative effect over time. The sixth-grade curriculum included 5 lessons that featured limit setting and refusal skills in nonsexual situations (e.g., pressures to steal, lie, or use drugs). The seventh-grade curriculum included 8 lessons that addressed determining personal limits regarding sexual intercourse, understanding the consequences of unplanned sexual intercourse (including STDs and pregnancy), using intra- and interpersonal skills (identifying risky situations and refusal skills) to maintain limits, and respecting others' limits. The eighth-grade curriculum included 7 lessons and featured an HIV-infected speaker, a condom demonstration plus a brief activity on other methods of protection, and practice of refusal skills in dating contexts. The lessons were sequential, with later lessons building on concepts from earlier ones. Lessons were interactive and used a variety of instructional strategies (e.g., small and large group discussions, paired and small-group skill practice,

stories, individual activities). Because the study schools included significant proportions of Latino youths, the curricula also included core concepts important in the Latino culture (e.g., *dichos*, or sayings, and respect). Further, all student worksheets and activities were provided in English and Spanish. Nonetheless, the curriculum was designed to be appropriate across racial/ethnic groups.

The curriculum was developed and pilot tested over a period of several years. Students in focus groups provided information about how youth think and feel about various topics related to sexuality and also provided feedback about lesson ideas. Each lesson activity was tested initially in schools that were not formally part of the study. Once the various activities were revised, lessons were created, and additional piloting and revision occurred. Finally, the full set of lessons for each grade was given to 10 or more classrooms of students in another school district and final revisions were made. Student feedback was used throughout the process to improve the lessons and make them more enjoyable.

During the study, experienced health educators were hired to teach the lessons. Project staff trained these health educators before implementation. The health educators also practiced implementing the curriculum by teaching it at a school not involved in the study. The curriculum was taught during a specified period at each school; the period was scheduled in cooperation with the schools. According to the school site coordinators, the curriculum served as the main source of HIV, other STD, and pregnancy prevention education in the intervention schools, although some schools implemented other minimal activities (e.g., limited instruction in science classes, brief presentations/assemblies).

### Data Collection Procedures

Trained data collectors administered self-report surveys at baseline and follow-up during regular 45- to 50-minute class periods. The baseline data were collected in spring 1997, when students were in sixth grade. Follow-up data were collected in spring 1998 (seventh grade), spring 1999 (eighth grade), and spring 2000 (ninth grade). The ninth-grade follow-up was 36 months after baseline and 1 year after the final year of inter-

vention. At all follow-up periods, students who could not be surveyed at school were surveyed by mail.

### Participants

Active written parental consent and student assent were required for survey participation. Ninety percent of students (3765/4164) in the study schools at baseline returned parental consent forms; 2898 (77%) of these parents consented to allow their children to complete the survey. Of these students, 2829 completed the baseline survey (68% of all students). Response rates for the seventh- and eighth-grade follow-up surveys were 91% and 88%, respectively. The response rate for the ninth-grade follow-up was lower (64%). The ninth-grade data point was added later in the study, and it was more difficult to track students who transitioned to high schools that had not been part of the project. The majority of the students (approximately 90% at baseline) completed the English version of the survey. In addition to obtaining written consent for survey participation, intervention schools obtained passive consent for program participation. Very few parents excluded their children from program participation.

Students' average age at baseline was 11.5 years. The gender mix was nearly equal (50.1% female). The racial/ethnic composition of the sample was as follows: 5.2% African American, 15.9% Asian, 59.3% Latino, 16.5% White, and 3.1% other. Approximately 4% of the students reported having had sexual intercourse at baseline. The intervention and control groups were equivalent on demographic variables assessed at baseline.

### Instrument

The student survey assessed demographics, sexual behaviors, and sexuality-related psychosocial factors. The instrument was initially developed in English and subsequently translated into Spanish; a back-translation procedure was used to ensure that the Spanish version was equivalent. Neither version was considered final until both versions were equivalent in meaning. Both measures were pilot tested.

The *sexual behavior outcome variables* included binary measures of sexual inter-

course (ever had sex), sexual intercourse in the past 12 months, and condom use at last intercourse. Additional items measured the numbers of sexual episodes and sexual partners during the past 12 months. The phrase *having sex* was defined as “a man’s penis in a woman’s vagina.” We also assessed coercive behaviors in the past 12 months (coercing others to kiss, touch, or have sexual intercourse when they did not want to), and unwanted sexual advances (being coerced by others to kiss, touch, or have sexual intercourse when it was unwanted). These 2 coercion variables were scaled and are summarized in Table 1. The *psychosocial scales* also are summarized in Table 1.

**Statistical Analyses**

*Primary Regression Analyses.* Repeated measures logistic and linear regression models estimated the treatment group effects, separately for boys and girls, on the study outcomes from baseline to the end of the ninth grade. Model estimates were based on generalized estimating equations<sup>26</sup> with an unstructured correlation matrix specified to account for the correlation of repeated measurements within respondents. Explanatory variables included an intervention group indicator, categorical time indicator, group-by-time interaction, student ethnicity, and the peer norm scale measured at baseline. The variation of schools within treatment groups was modeled by a fixed nested effect. Custom contrasts

were used to estimate group differences at each grade level as well as the groups-by-time and groups-by-square-root-time interactions. Generally, outcome levels were a function of the square root of time for boys and a linear function of time for girls; exceptions are noted. *R*<sup>2</sup> values for models of behavioral outcomes also are reported.<sup>27</sup>

Preliminary analyses revealed baseline differences between intervention and control groups in reports of ever having had sex. Percentages for boys in the intervention and control groups were 6.34 and 4.33 (*P* < .07). For girls, percentages were 3.99 and 2.78 (*P* < .20) for intervention and control groups, respectively. To control for these differences, we included the baseline peer norm covari-

**TABLE 1—Scale Information for Psychosocial and Other Scaled Variables**

Variable	Number of Items	Sample Item	Response Format <sup>a</sup>	$\alpha$
Knowledge (about HIV and condoms)	6	Is it against the law for people younger than 16 years old to buy condoms?	2-point scale (1 = correct, 0 = incorrect)	Not reported
<b>Attitudes</b>				
Reasons for having sex	7	I would have sex now so my boy/girl friend would not break up with me.	3-point scale (1 = not true for me, 2 = not sure, 3 = true for me)	.88
Reasons for <i>not</i> having sex	8	I would not have sex at my age because I don't want to have a bad reputation.		.85
<b>Normative beliefs</b>				
Beliefs supporting popularity with sex	2	Are girls more popular if they have sex?	5-point scale (1 = definitely no to 5 = definitely yes)	.84
Peer beliefs favoring sex	6	How many of your friends think people your age should wait until they are older to have sex?	5-point scale (1 = none to 5 = all)	.72
Beliefs favoring pressure for sex	1 per gender group	Is it OK for a <i>boy</i> to pressure a <i>girl</i> to have sex if they have had sex before?	5-point scale (1 = definitely not OK to 5 = definitely OK)	NA
Self-efficacy to refuse sexual activity	8	Imagine you are alone with someone you like very much. Could you stop them if they wanted to touch your private parts below the waist?	4-point scale (1 = I definitely could not to 5 = I definitely could)	.89
Sexual limits	4	Imagine you are alone with someone you like very much. Would you let them touch your private parts below the waist?	4-point scale (1 = definitely yes to 4 = definitely not)	.86
Situations that could lead to sexual behavior	4	In the past 3 months, how often have you been alone kissing and touching someone you really like?	4-point scale (1 = never to 4 = 6 or more times)	.81
Coercive behavior	4	In the past 12 months, have you tried to touch someone's private parts below the waist, but they didn't want you to?	2-point (1 = no, 2 = yes)	.74
Unwanted sexual advances	4	In the past 12 months, has someone tried to touch your private parts below the waist when you didn't want to?	2-point (1 = no, 2 = yes)	.74

Note: NA = not applicable.

<sup>a</sup>Mean scores were used in all analyses.

ate because it was significantly related to baseline reports of ever having sexual intercourse. After control for baseline peer norms, the baseline differences between the intervention and control groups on the variable *ever had sex* were greatly diminished (both *P* values <.60).

**Mediation Analyses.** Additional analyses determined whether group membership affected each measured psychosocial construct assessed at the end of eighth grade. These analyses were conducted separately for boys and girls and also included ethnicity and baseline peer norms as explanatory variables. Next, the ninth-grade indicator of sexual intercourse in the past 12 months was regressed on the treatment group indicator, ethnicity, baseline peer norms, and all psychosocial constructs that were at least weakly related to group membership (*P*<.10). When primary regression analyses found treatment effects on sexual intercourse in the past 12 months, these subsequent analyses tested whether the psychosocial constructs mediated that effect.<sup>28,29</sup> When primary analyses found no treatment effects, these analyses provided additional insight into the effect of the treatment group assignment on the psychosocial variables. We used *sexual intercourse in the past 12 months* rather than *ever had sex* as the outcome for these analyses because some youth initiated intercourse before the eighth-grade assessment.

These models were fit within the logistic and ordinal logistic regression framework. Associated direct effects were reported as odds ratios with 95% confidence intervals. When the psychosocial constructs were modeled as explanatory variables, standardized odds ratios of their effects were reported. When the psychosocial constructs were modeled as outcomes, they were first coarsened to have 5 ordered categories, and ordinal logistic regression models were fit.

**Multiple Imputation.** Each model was fit to 20 multiply-imputed data sets created with SAS PROC MI.<sup>30</sup> The imputation model included all outcome and explanatory variables described in this article. Because PROC MI assumes a multivariate normal distribution, imputed values for binary and ordinal variables were subsequently rounded to the nearest applicable integer.<sup>31</sup> All pa-

rameter estimates and significance tests were calculated by combining results across the imputed data sets.<sup>32,33</sup>

**RESULTS**

**Attrition**

Overall retention rates were 91%, 88%, and 64% in seventh, eighth, and ninth grades, respectively. Generally, differential rates of attrition across treatment groups did not appear to be a problem. A longitudinal analysis regressed student retention indicators measured in seventh, eighth, and ninth grades on intervention group assignment, gender, time, ethnicity, and all interactions, as well as the fixed effect of schools nested within treatment groups. All 3- and 4-way interactions were insignificant and were dropped from the model. Four effects were significant: (1) time, *P*<.0001; (2) gender by time (retention declined more rapidly for boys [90%, 87%, 56%] than for girls [92%, 90%, 71%], *P*<.01; (3) race/ethnicity by time (retention declined more rapidly for some racial/ethnic groups [ninth-grade retention rates equaled 55%, 59%, 66%, 72%, and 78% for African Americans, Latinos, Asians, Others, and Whites, respectively]), *P*<.05; and (4) intervention group by race/ethnicity (within each racial/ethnic group

there were no significant differences in retention across treatment groups. However, among Whites, retention was highest in the intervention group, whereas among African Americans, Latinos, and Others, retention was highest in the control group, *P*<.01.

**Behavioral Outcomes**

**Sexual Intercourse—Ever.** After the Draw the Line/Respect the Line program, boys in the intervention group were significantly less likely than boys in the control group to report ever having sex (model *R*<sup>2</sup>=0.118; Table 2). Specifically, there was a statistically significant group-by-time interaction indicating that from sixth through ninth grades, boys in the intervention schools were less likely to report sexual activity than boys in the control schools (*P*=.01), and this difference increased across time. Similarly, at each follow-up measurement time point (seventh, eighth, and ninth), significantly fewer boys in the intervention schools reported having sex than boys in the control schools (*P*=.04, *P*=.01, and *P*=.02, respectively). There were no statistically significant effects on this outcome among girls (model *R*<sup>2</sup>=0.145).

**Sexual Intercourse—Past 12 Months.** There were no statistically significant group-by-time effects for boys or girls on whether or not

**TABLE 2—Adjusted Percentage in Each Grade and Gender Reporting Sexual Intercourse Ever and in the Last 12 Months by Intervention Condition (n=2829): California, 1997-2000**

Outcome	Adjusted Percentage for Boys			Adjusted Percentage for Girls		
	Intervention	Control	<i>P</i>	Intervention	Control	<i>P</i>
Ever had sex						
Group × time interaction			<b>.01</b>			.41
Sixth grade (baseline)	4.7	3.6	.29	2.7	2.2	.51
Seventh grade	10.2	14.4	<b>.04</b>	6.1	5.9	.84
Eighth grade	14.6	21.9	<b>.01</b>	11.7	10.6	.59
Ninth grade	19.3	27.2	<b>.02</b>	20.3	22.1	.53
Had sex in the past 12 mo						
Group × time interaction			.14			.37
Sixth grade (baseline)	2.8	2.9	.88	1.5	1.1	.53
Seventh grade	6.9	11.3	<b>.01</b>	4.8	4.4	.72
Eighth grade	10.9	18.6	<b>.002</b>	8.8	8.6	.75
Ninth grade	17.3	24.5	<b>.03</b>	18.2	19.9	.52

*Note.* All models included the following variables: baseline peer norms, group (intervention vs comparison), time, ethnicity, and group-by-time interaction (square root of time was modeled for boys). Boldface indicates a statistically significant effect.

**TABLE 3—Adjusted Mean Scores on Psychosocial and Behavioral Determinants by Intervention Condition and Gender (n = 2829): California, 1997–2000**

Outcome (scale range)	Boys			Girls		
	Intervention	Control	P	Intervention	Control	P
<b>Knowledge (0–1)<sup>a</sup></b>						
Group × time interaction			<b>.000</b>			.13 <sup>b</sup>
Sixth grade (baseline)	0.56	0.58	.10	0.58	0.55	<b>.05</b>
Seventh grade	0.65	0.62	<b>.04</b>	0.68	0.62	<b>.000</b>
Eighth grade	0.76	0.70	<b>.000</b>	0.79	0.70	<b>.000</b>
Ninth grade	0.79	0.75	<b>.01</b>	0.82	0.79	<b>.04</b>
<b>Attitudes</b>						
Attitudes favoring reasons for having sex (1–3) <sup>c</sup>						
Group × time interaction			.16			.74
Sixth grade (baseline)	1.42	1.42	.80	1.22	1.20	.41
Seventh grade	1.49	1.50	.73	1.23	1.21	.30
Eighth grade	1.48	1.52	.16	1.25	1.23	.31
Ninth grade	1.55	1.59	.18	1.36	1.35	.46
Attitudes favoring reasons for not having sex (1–3) <sup>a</sup>						
Group × time interaction			<b>.003</b>			.24 <sup>b</sup>
Sixth grade (baseline)	2.45	2.50	.10	2.73	2.69	.10
Seventh grade	2.36	2.34	.61	2.61	2.60	.80
Eighth grade	2.23	2.20	.32	2.58	2.56	.39
Ninth grade	2.10	2.03	.08	2.44	2.45	.68
<b>Beliefs supporting popularity with sex (1–5)<sup>c</sup></b>						
Group × time interaction			.74			.51
Sixth grade (baseline)	2.00	2.12	.08	1.74	1.78	.51
Seventh grade	2.29	2.28	.79	1.97	1.97	.83
Eighth grade	2.21	2.42	<b>.002</b>	1.96	2.01	.41
Ninth grade	2.40	2.48	.22	2.17	2.14	.63
<b>Peer normative beliefs favoring sex (1–5)<sup>c</sup></b>						
Group × time interaction			<b>.001</b>			<b>.02</b>
Sixth grade (baseline)	NA	NA		NA	NA	
Seventh grade	2.39	2.36	.57	2.15	2.10	.23
Eighth grade	2.60	2.67	.13	2.38	2.39	.76
Ninth grade	2.94	3.06	.06	2.74	2.82	.17
<b>Normative beliefs favoring boys pressuring girls for sex (1–5)<sup>c</sup></b>						
Group × time interaction			.17			.09 <sup>b</sup>
Sixth grade (baseline)	1.96	1.91	.46	1.54	1.57	.55
Seventh grade	2.13	2.04	.29	1.66	1.61	.43
Eighth grade	2.04	2.11	.34	1.58	1.48	.09
Ninth grade	1.98	2.02	.50	1.47	1.42	.37
<b>Normative beliefs favoring girls pressuring boys for sex (1–5)<sup>c</sup></b>						
Group × time interaction			.23			.07 <sup>b</sup>
Sixth grade (baseline)	2.06	2.12	.43	1.54	1.59	.43
Seventh grade	2.24	2.27	.69	1.70	1.65	.41
Eighth grade	2.15	2.41	<b>.003</b>	1.60	1.53	.21
Ninth grade	2.19	2.29	.27	1.51	1.45	.29

Continued

they reported sexual activity in the 12 months before each survey administration (model  $R^2=0.105$  and  $0.140$ , respectively). Nonetheless, for boys, there was a statistically significant effect at each follow-up assessment period—boys receiving Draw the Line/Respect the Line were less likely than boys in the control group to report having had sex in the 12 months before the survey in seventh, eighth, and ninth grades (Table 2). This pattern of results suggests that although the intervention and comparison groups differed at each time point, the divergence, or spread, of the group trends was not sufficient to result in a significant groups-by-time interaction.

We also examined the effects of the intervention on the *number of times students had sexual intercourse in the past 12 months* and the *number of sexual partners* in that same time period (data not shown). We found no statistically significant group-by-time effects for boys or girls on either variable; however, among boys, there were statistically significant effects on both variables at the eighth grade follow-up favoring the intervention group boys ( $P=.01$  and  $.02$ , respectively). These effects diminished somewhat by ninth grade ( $P=.09$  and  $.13$ , respectively). No such treatment effects were found for girls.

**Condom Use.** There were no statistically significant treatment group-by-time effects among sexually active boys or girls for condom use at last intercourse (data not shown). Further, none of the pairwise comparisons at each time point were statistically significant.

**Psychosocial and Behavioral Determinants**

Table 3 includes results on the extent to which the intervention affected 12 psychosocial and behavioral determinants from sixth to ninth grade. Both group-by-time interactions and pairwise group comparisons at each measurement point are reported. Based on the group-by-time interactions and supported by evidence from the pairwise comparisons, boys in the intervention condition exhibited significantly greater HIV and condom-related knowledge than control students ( $P<.001$ ), had more positive attitudes toward *not* having sex ( $P=.003$ ), perceived fewer peer norms supporting sex ( $P=.001$ ), had stronger sexual limits ( $P=.004$ ), and were less likely to place

TABLE 3—Continued

Self-efficacy to refuse sexual activity (1-4) <sup>a</sup>						
Group × time interaction			.71			.06 <sup>b</sup>
Sixth grade (baseline)	3.22	3.17	.22	3.53	3.49	.24
Seventh grade	3.08	3.15	.15	3.51	3.53	.54
Eighth grade	3.06	3.03	.62	3.51	3.54	.27
Ninth grade	3.08	3.00	.18	3.53	3.55	.35
Sexual limits (1-4) <sup>a</sup>						
Group × time interaction			<b>.004</b>			.59
Sixth grade (baseline)	3.00	2.98	.58	3.43	3.41	.49
Seventh grade	2.66	2.57	.13	3.02	3.03	.81
Eighth grade	2.37	2.24	<b>.02</b>	2.82	2.82	.87
Ninth grade	2.18	2.00	<b>.001</b>	2.67	2.64	.44
Situations that could lead to sexual behavior (1-4) <sup>c</sup>						
Group × time interaction			<b>.000</b>			.17 <sup>b</sup>
Sixth grade (baseline)	1.46	1.43	.44	1.27	1.29	.45
Seventh grade	1.64	1.73	.06	1.49	1.54	.14
Eighth grade	1.78	1.90	<b>.02</b>	1.69	1.76	.09
Ninth grade	1.88	2.06	<b>.002</b>	1.93	2.02	.11
Engaged in coercive sexual behavior in past 12 mo (1-2) <sup>c</sup>						
Group × time interaction			.21			.07 <sup>b</sup>
Sixth grade (baseline)	1.08	1.07	.61	1.02	1.03	.40
Seventh grade	1.11	1.11	.83	1.05	1.05	.59
Eighth grade	1.11	1.12	.40	1.05	1.04	.71
Ninth grade	1.12	1.13	.43	1.05	1.04	.15
Reported unwanted sexual advances in past 12 mo (1-2) <sup>c</sup>						
Group × time interaction			.46			.08
Sixth grade (baseline)	1.14	1.15	.57	1.12	1.13	.32
Seventh grade	1.17	1.18	.58	1.18	1.18	.78
Eighth grade	1.19	1.19	.80	1.20	1.24	<b>.02</b>
Ninth grade	1.19	1.23	.12	1.25	1.29	.06

Note. NA = not applicable: because all models were adjusted for baseline peer norms, the baseline mean values of peer norms were not estimated. All models included the following variables: baseline peer norms, group (intervention vs comparison), time, ethnicity, and group-by-time interaction (the square root of time was modeled for boys). Boldface indicates a statistically significant effect.

<sup>a</sup>Higher scale values represent the desired direction.

<sup>b</sup>Time effects for girls on this variable were modeled as the square root of time.

<sup>c</sup>Lower scale values represent the desired direction.

themselves in situations that could lead to sexual behaviors ( $P < .001$ ). There were 3 significant findings for girls. Specifically, at each time point, girls in the intervention group showed significantly greater HIV and condom knowledge than control group girls ( $P < .05$ ); girls in the intervention condition perceived fewer peer norms supporting sexual intercourse than did girls in the control condition ( $P = .02$ ), although this finding was not evident in the pairwise comparisons; and girls in the intervention group reported significantly

fewer incidents of unwanted sexual advances at the eighth-grade follow-up than did girls in the control group ( $P = .02$ ).

### Mediation-Type Analyses

A final set of analyses determined whether intervention group assignment was related to each of the psychosocial constructs measured in eighth grade and whether the affected psychosocial constructs were associated with reports of sexual intercourse in the past 12 months as measured during ninth grade.

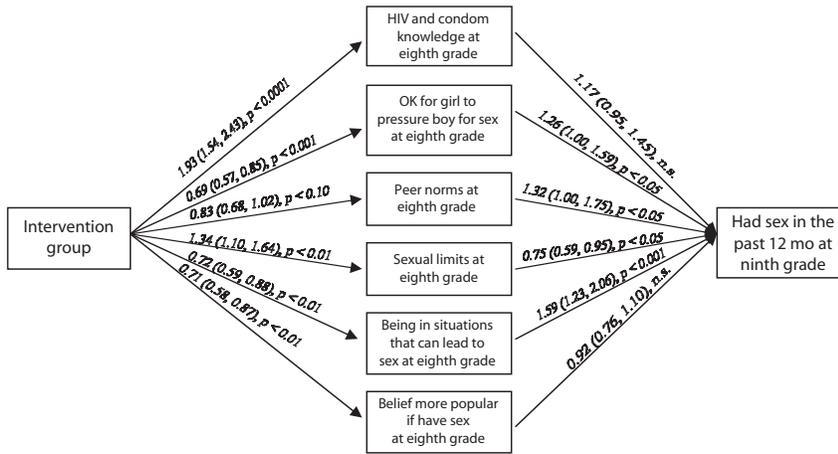
These analyses tested whether the psychosocial constructs mediated the intervention effect for boys. For girls, no intervention effect was noted, and the analyses helped to document any limited impact of the intervention.

For boys, intervention group assignment was found to affect 6 of the 12 psychosocial constructs measured in eighth grade (Figure 1). A final model regressed ninth-grade reports of sexual intercourse in the past 12 months on all 6 psychosocial constructs as well as the intervention group, ethnicity, and baseline peer norm measures. The conditional effect of the intervention group was not significant, suggesting that the psychosocial measures mediated the treatment effect (odds ratio [OR] = 0.81, 95% confidence interval = 0.55, 1.20),  $P = .28$ . Being in situations that could lead to having sex appeared to be the strongest mediator. Intervention group boys reported being in fewer such situations (OR = 0.72), whereas being in such situations was significantly related to reports of having sexual intercourse in the last 12 months (OR = 1.59).

For girls, the intervention group influenced 4 of the psychosocial constructs measured in eighth grade (Figure 2). The final model regressed ninth-grade reports of having had sexual intercourse in the last 12 months on these 4 psychosocial constructs as well as the intervention group indicator, ethnicity, and baseline peer norm measures. The intervention appeared to be successful in increasing knowledge, reducing reports of unwanted sexual advances, and, to a lesser extent, reducing reports of being in situations that could lead to sexual intercourse. Two of these constructs (all but knowledge) were, in turn, related to having had sex in the last 12 months. Nonetheless, the intervention had no overall impact on the sexual activity of girls.

## DISCUSSION

Our findings suggest that the Draw the Line/Respect the Line curriculum produced several positive and programmatically important behavioral effects among boys in the cohort, but not among girls. Gender-specific effects on sexual behavior are not unique. Other studies have reported similar results—some favoring males<sup>34,35</sup> and some favoring



Note. ns = not significant.

**FIGURE 1—Psychosocial variables (odds ratio [95% confidence interval], P) that mediate intervention group effects on boys' reports of sexual intercourse during the past 12 months at the ninth-grade follow-up.**

females.<sup>14,36</sup> Those studies finding no effects for females suggest that girls may need more intense skill-building opportunities, more support for handling coercion, and a more supportive social environment (e.g., one that addresses gender role and peer influences). Our findings support these conclusions and yield new ones. Our data reported elsewhere<sup>37</sup> suggest that the influence of older boyfriends may have contributed to the lack of effects for girls. Almost 30% of eighth-grade girls in this study had a boyfriend 2 or more years older, and these girls were much more likely to report having had sex.<sup>37</sup> Our intervention did not address this risk factor nor did it prepare girls on how to counter pressure from an

older partner. Coercion also may have been a factor. Other studies support this as a potentially important factor for girls.<sup>35,38,39</sup> As we found, however, small changes in this factor were not sufficient to produce a treatment effect for girls. Clearly, additional research is needed to better understand factors influencing girls' decisions to engage in sexual intercourse so that more effective interventions can be developed. Our study also supports the long-held finding that increasing knowledge alone is not enough to yield changes in sexual behavior.<sup>6</sup>

In contrast, for the boys, this intervention may have created a new norm within the school environment—one that made boys

more comfortable with the idea of refraining from sex. Many studies support the importance of the influence of peer norms on sexual behavior.<sup>6,40,41</sup> The Draw the Line/Respect the Line intervention also provided boys with a crucial skill—recognizing and avoiding situations that might lead to sexual intercourse. Our mediation analyses suggest that this factor is the most important behavioral mediator of those we studied. Not many other published studies have reported data on this variable as we have constructed it, although Murphy et al.<sup>42</sup> found that males had lower perceived ability to plan ahead and avoid risky situations than did females. The mediation analyses also suggest that having strong sexual limits and believing that girls should not pressure boys for sex are important factors that can be influenced by intervention.

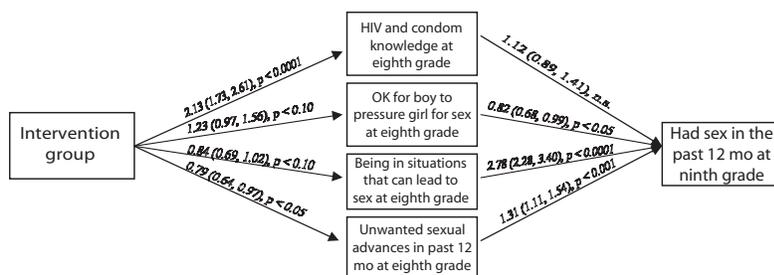
Contrary to expectations, we found no effects on condom use at last intercourse for boys or girls. Because so few students in the sample were engaging in recent sexual activity (i.e., within 3 months before the survey), our statistical power to detect changes for condom use at last intercourse was limited.

### Study Limitations

Despite a strong study design, several methodological limitations should be noted. The outcome data were collected using self-report questionnaires. Although it is impossible to rule out potential biases due to self-report, some evidence supports the general reliability and validity of adolescents' reports of sexual and contraceptive behaviors.<sup>43,44</sup>

We also experienced a relatively high level of nonparticipation in the survey at baseline (24% of students who returned consent forms were denied participation in the survey). Although we do not have demographic data on these students, we do know that the majority of parents who refused participation did so because they felt their children were too young to complete a survey on sexual behaviors.

Students lost to follow-up differed from students retained in the cohort. Across time, attrition rates of boys, African Americans, and Latinos increased more rapidly than those of girls and the other racial/ethnic groups. Further, a significant interaction suggested that attrition among White students was highest in the control group, whereas



Note. ns = not significant.

**FIGURE 2—Psychosocial variables (odds ratio [95% confidence interval], P) related to intervention group assignment among girls, and their effects on reports of sexual intercourse during the past 12 months at the ninth-grade follow-up.**

attrition among the Latino, African American, and other groups was highest within the intervention group. To the extent that the data were not missing at random,<sup>45</sup> or at least approximately so, attrition could potentially bias the study results. However, our use of a rich imputation model limited this threat.

## Conclusions

Draw the Line/Respect the Line was successful in delaying sexual initiation among boys over a period of 36 months. This is one of the first large-scale randomized trials in a school-based setting targeting schools with large proportions of Latino youth. No other study has yielded similar long-term effects for middle school youth. This study suggests that a theory-driven, school-based curriculum can reduce sexual risk behavior among boys. More research is needed to understand factors that influence sexual initiation among girls, and the results of such research could then be used to enhance the effectiveness of prevention interventions for girls. Given the pattern of effects, this program might be particularly appropriate in community-based settings that provide programs for boys (e.g., the YMCA or male involvement programs), though implementing a multiyear program in these settings could be challenging. If the program is adopted in general school settings with mixed gender classrooms it should be augmented with lessons that address the influence of older partners. ■

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## Contributors

B. Marin, K. Coyle, C. Gómez, and D. Kirby conceived the study, developed the curriculum, and supervised all aspects of the study. S. Gregorich developed the analysis plan and conducted the data analyses. K. Coyle and S. Gregorich led the writing of the article. All authors took part in interpreting the study findings and reviewing drafts of the article.

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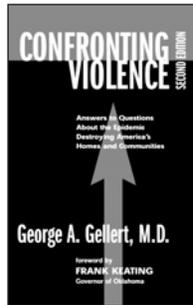
## Human Participant Protection

The study was reviewed and approved by the institutional review board of the University of California, San Francisco.

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# Adolescents and Firearms: A California Statewide Survey

Susan B. Sorenson, PhD, and Katherine A. Vittes, MPH

Firearms figure prominently in the lives and deaths of US adolescents. About 6% of high school students and 10.3% of male students across the United States reported that they carried a firearm at least once during the past 30 days,<sup>1</sup> and nearly half said, that if they wanted to, they could get a gun.<sup>2</sup> About one fourth reported having easy access to a gun in the home.<sup>3</sup> Crude odds ratios indicate that having a gun in the home is associated with demographic characteristics such as gender, ethnicity, and welfare status.

In 2000, 3913 US youths aged 10 to 19 years died from an intentional gunshot wound<sup>4</sup>; intentional firearm injury is second only to all unintentional injuries as a cause of death for this age group.<sup>5</sup> Although it is illegal, with a few exceptions, for persons under 18 years old to possess a firearm,<sup>6</sup> they are more likely than persons older than 18 years to use a firearm to kill themselves or someone else.<sup>7</sup> For every gun death among 15- to 19-year-old youths, there are nearly 4.5 nonfatal hospital-treated gunshot injuries.<sup>8</sup>

We examined the patterns and correlates of knowledge about and possession of firearms in a community-based sample of adolescents. (Research on adolescents and firearms typically uses more specialized samples such as high school students<sup>3,9-20</sup> or incarcerated youths<sup>21-24</sup> from a single, often urban, locale.<sup>9-12,24,25</sup>) Our first objective was to examine adolescents' reports of having a firearm in their immediate environment (i.e., in the household or of one's own) and the demographic correlates of these reports. The second objective was to compare correlates of having a firearm in one's immediate environment with correlates of perceptions regarding the firearms of other adolescents (close friends and same-aged peers). In addition to firearms in general, we asked specifically about handguns, given that handguns are relatively easy to conceal and are the most common type of weapon used in homicides and suicides.<sup>26-29</sup>

**Objectives.** We assessed the prevalence and correlates of adolescents' reports regarding firearms in their homes, of their own, of close friends, and of same-aged peers.

**Methods.** Random-digit-dialed interviews were conducted with 5801 adolescents as part of the California Health Interview Survey.

**Results.** One fifth (19.6%) of California adolescents reported having a firearm in their homes; few (3.0%) reported having their own gun. Characteristics associated with having one's own gun and with perceptions regarding others' guns generally were consistent with characteristics associated with having a firearm in the home. The 2 exceptions were related to socioeconomic status and to ethnicity.

**Conclusions.** The source from which adolescents obtain guns, especially adolescents from less wealthy households, merits further investigation. Further research is needed to ascertain the accuracy of Black and Latino adolescents' perceptions regarding handguns among their peers. (*Am J Public Health.* 2004;94:852-858)

## METHODS

The California Health Interview Survey (CHIS), the largest statewide health survey in the nation, collects data on multiple public health issues, including health status, behaviors, and access to care. CHIS 2001 is a random-digit-dialed telephone survey of adults, adolescents, and children. Detailed methodological information is available elsewhere.<sup>30</sup>

All California households with a telephone comprised the sampling frame. Each computer-generated telephone number was screened to determine eligibility (e.g., language fluency); 1 adult per household was randomly selected to be interviewed. If the interviewed adult was the parent or guardian of an adolescent residing in the household, the adult was asked to give verbal consent for the adolescent to be interviewed. If the adult agreed, consent was requested from the adolescent. If more than 1 adolescent resided in a given household, 1 was selected at random. About 1 in 6 sampled adults had an eligible adolescent, and 63.5% allowed an adolescent to be interviewed. Of these adolescents, most (84.5%) agreed to be interviewed. Data were collected from 55 428 households; 5801 adolescents were interviewed between November 2000 and October 2001.

Interviews were conducted in English, Spanish, Chinese (Mandarin and Cantonese

dialects), Vietnamese, Korean, and Khmer. These languages were selected to include the largest possible number of non-English speaking California residents. About 9% of the adolescents were interviewed in a language other than English.

## Measures

Adolescents were asked seven questions about firearms in general, and handguns in particular. Respondents were asked whether there was a gun in their home, whether they personally had a gun, whether there was a gun in the homes of their 2 closest friends, and whether 1 or both of these friends personally owned a gun. These questions also were asked about handguns; in addition, respondents were asked whether they knew someone about their own age who had a handgun (see Table 1 for a list of the questions). The question about whether the adolescent had a firearm specified "either at home or somewhere else." (The terms "house" and "household" are used interchangeably.)

Demographic information was gathered from each adolescent and adult.

## Statistical Analyses

Sample weights, person-level weights, and population weights were employed. These weights accounted for, among other variables, nonresponse, multiple telephone lines, and

**TABLE 1—Survey Questions About Firearms**

Now I'd like to talk with you about firearms. When I say firearms or guns in all of these next questions, I mean rifles, shotguns, pistols, revolvers, or other firearms. I do NOT want you to include BB guns, air guns, or toy guns.

Does any member of your household happen to keep a firearm at home? It could be kept in your home, garage, outdoor storage area, car, truck, or other motor vehicle.

If yes: How many are handguns?

Do you yourself have a gun, either at home or somewhere else?

If yes: How many guns do you have? Is this a handgun?/Are any of these handguns?

Think of the two friends you spend the most time with.

Are there guns in either of their homes?

If yes: Are any of those guns handguns?

Do one or both of these friends own a gun themselves?

If yes: Is this a handgun?/Are any of these handguns?

Do you know any people around your age who have a handgun?

within-household probability of selection and adjusted for gender, age, race, ethnicity, urbanization, number of children, and number of adolescents in the household. Thus, our findings can be considered a reasonable approximation of firearm prevalence among adolescents in California.

Frequencies were calculated and were followed by bivariate tabulations and  $\chi^2$  tests of significance. Standard diagnostics were performed before further analysis; the bivariate linear correlations were acceptable. Multivariate logistic regressions were conducted to identify demographic correlates of reporting having a firearm (vs having no firearm) in the household or of one's own and of reporting that a close friend had a firearm in the home or of his or her own. We conducted the same analyses for handgun versus no handgun. The final set of analyses focused on whether the respondent believed that a same-aged peer had a handgun.

**RESULTS**

A substantial minority of California adolescents reported having a firearm in their immediate environment. Nearly 1 in 5 (19.6%) reported living in a home in which there was a firearm, and 3.0% reported having their own gun. When asked about their 2 closest friends, 13.3% said that there was a firearm in at least 1 of those friends' homes, and 4.7% said that at least 1 of those friends had his or her own gun.

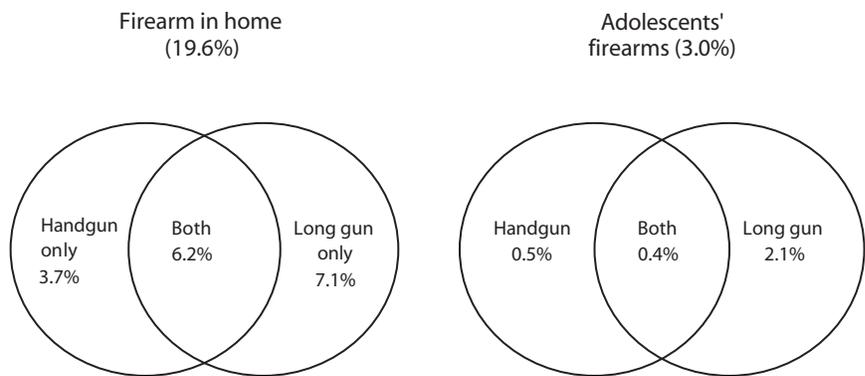
Long guns were the most common type of firearm in the adolescent's immediate environment (Figure 1). About 1 in 10 (9.9%) reported living in a home in which there was a handgun, and less than 1% (0.86%) reported that they had their own handgun. About half (44.2%) of the adolescents who had a handgun reported that it was a gift from their parents. When asked about their 2 closest friends, 6.7% said that there was a handgun in at least 1 of their friends' homes, and 1.9% reported that at least 1 of these 2 friends owned his or her own handgun. Nearly one fifth (18.5%) of California adolescents believed that they knew someone about their own age who had a handgun.

Bivariate analyses indicate that some population subgroups were more likely to have

firearms than others (Table 2); with few exceptions, nearly all tabulations were statistically significant at  $P < .05$ . Greater proportions of boys, older adolescents, Whites, citizens, and employed adolescents reported that there was a gun in each of the identified locales than did girls, younger adolescents, non-Whites, non-citizens, and unemployed adolescents. Parent/guardian characteristics positively associated with guns were having a higher income, being a US citizen, and having a marital status of other (i.e., widowed, divorced, separated, or living together). A greater proportion of rural (vs urban) adolescents responded affirmatively to the gun questions.

Household composition (i.e., number of children, adolescents, adults, total number of residents) was generally unrelated to answers to the gun questions (data not shown). Moreover, preliminary multivariate analyses indicated that school attendance, the adolescent's plans for the future, and parental marital status were generally unrelated to answers to the gun questions. These variables, therefore, were not included in the final models. Percentage of federal poverty level was used to estimate socioeconomic status in the multivariate analyses, because the federal poverty level accounts for household income and number of persons residing in the household and is adjusted each year for inflation.<sup>31</sup>

When all other variables listed in the table were taken into account, each of the measured demographic characteristics was associated with the likelihood of adolescents'



**FIGURE 1—Adolescents' reports of having a firearm in the home and of having their own firearm.**

**TABLE 2—Prevalence of Firearms or Handguns, (%), by Demographic Characteristics: California Adolescents**

Characteristic (%)	Firearm				Handgun				
	In Home	Adolescent Has	In Friend's Home	Friend Owns	In Home	Adolescent Has	In Friend's Home	Friend Owns	Peer Has
Overall weighted estimates	19.6	3.0	13.3	4.7	9.9	0.9	6.7	1.9	18.5
<b>Adolescents (individual-level variables)</b>									
<b>Gender</b>									
Male (51.4)	21.1	5.1	17.9	7.2	11.9	1.5	9.2	2.6	22.5
Female (48.6)	18.0	0.7	8.6	2.0	7.8	0.7	4.1	1.1	14.2
<b>Age, y</b>									
12 (16.4)	14.1	1.9	7.8	1.9	6.6	1.0	3.2	0.6	7.8
13 (17.7)	17.8	2.0	10.0	4.3	8.3	0.2	4.0	1.5	8.6
14 (16.5)	18.5	2.6	11.3	3.4	10.6	0.5	4.7	1.2	15.9
15 (16.7)	18.8	3.9	14.0	5.8	10.1	1.1	6.7	2.2	24.6
16 (16.0)	25.4	4.0	18.6	5.9	12.0	1.9	10.5	2.3	27.8
17 (16.0)	23.5	3.4	18.7	6.8	11.8	0.8	11.6	3.5	26.8
<b>Ethnicity</b>									
White (46.4)	29.5	5.5	18.6	5.7	14.9	1.3	8.7	1.5	18.1
Black (6.7)	14.7	2.5	12.5	6.8	6.5	2.1	8.1	2.0	26.5
Latino (35.8)	10.5	0.5	8.7	3.5	5.4	0.4	5.0	2.3	17.4
Asian (8.5)	9.7	1.1	5.6	2.7	5.0	0.7	3.3	1.7	15.6
Multiethnic, other (4.7)	20.4	1.8	14.6	4.7	10.4	0.3	6.3	2.6	23.3
<b>Citizenship</b>									
Noncitizen (7.3)	2.2	0.2	5.0	3.2	0.9	0.2	4.0	1.8	12.1
Citizen (92.7)	21.7	3.3	14.3	4.8	10.9	1.0	7.1	1.9	19.2
<b>Attends school</b>									
No (2.0)	18.4	1.8	24.3	7.1	5.9	1.5	6.4	5.5	23.3
Yes (98.0)	19.5	3.0	13.1	4.6	10.0	0.9	6.7	1.8	18.4
<b>Works for pay</b>									
No (58.1)	15.7	1.6	9.4	2.7	7.4	0.5	4.7	1.1	15.0
Yes (41.9)	25.2	4.8	18.8	7.4	13.4	1.5	9.6	3.0	23.3
<b>Future plans</b>									
College/university (70.1)	18.5	2.3	11.9	3.8	9.1	0.6	5.9	1.5	17.0
Junior college/tech (11.6)	28.0	4.8	17.7	7.0	14.8	1.4	9.4	2.1	21.4
Get a job (4.2)	18.2	3.1	13.4	6.8	9.3	0.5	8.3	3.4	18.1
Military (3.6)	17.5	8.4	18.9	11.4	9.3	1.4	10.8	5.1	31.0
Other/get married (3.7)	21.3	4.8	17.3	6.8	12.5	4.2	9.5	3.1	21.1
<b>Parents (household-level variables)</b>									
<b>Education</b>									
Less than high school (15.6)	7.5	0.8	7.2	3.5	3.5	0.5	4.1	2.5	16.7
Grade 12/high school graduate (9.4)	10.7	2.0	13.2	2.8	4.3	1.3	7.9	1.8	15.5
Some college (25.5)	26.3	3.8	16.2	5.5	12.8	1.0	8.0	2.0	20.7
BA or BS degree (16.1)	20.9	2.8	13.9	3.9	10.6	0.3	5.9	1.0	17.6
Graduate school (10.4)	23.3	2.1	14.5	4.8	10.3	0.5	6.3	0.9	16.9
<b>Marital status</b>									
Never married (8.3)	14.7	2.7	12.3	3.8	5.9	1.2	5.7	1.8	22.6
Married (65.3)	19.9	2.5	12.3	4.3	10.0	0.7	6.4	1.7	17.0
Other (26.1)	20.7	4.2	16.3	5.9	11.0	1.3	8.0	2.3	20.9

Continued

reporting a firearm in their home or that they had their own gun (Table 3). Males (vs females) and adolescents of high school age (14–17 years old) (vs those of junior high school age, 12 and 13 years old) had greater odds of having firearms in their immediate environment. By contrast, the adjusted odds of having a gun in the home were lower for Blacks, Latinos, and Asian Americans compared with Whites. Latino adolescents and those who self-identified as multiethnic or “other” had substantially lower odds of having their own gun. All else being equal, adolescents who were or whose parents were US citizens had substantially higher odds of having a firearm in the home; the latter group also had higher odds of having their own gun. Although employment status was not associated with having a firearm in the home, employed adolescents were more likely than unemployed adolescents to report having their own gun. The association between financial status of a household and whether that household contained a firearm is nearly linear. (Note that adjusted odds ratios in Table 3 are generally consistent with the bivariate socioeconomic status data in Table 2.) Adolescents from rural areas had higher odds of having a firearm in their immediate environment than did their urban peers.

The demographic correlates of perceptions regarding the firearms of other adolescents were generally consistent with the correlates of having a firearm in one’s immediate environment (i.e. in the home or of one’s own). In addition, the odds of having 1 or 2 close friends who had a gun in their home was lower for Latino and Asian American adolescents (95% CI=0.43, 0.86; and 95% CI=0.25, 0.75, respectively). However, citizenship status and household financial status were not related to reports of firearms associated with adolescents’ 1 or 2 closest friends.

Although there were a few exceptions, the substantive patterns observed for any gun or guns held for handguns (see right-hand columns of Table 3).

In sum, male adolescents and adolescents who were of high school age, who were employed, or who lived in rural areas had higher odds of reporting that there are firearms, including handguns, in their environment. Adolescents who were US citizens had higher

TABLE 2—Continued

Citizenship									
Noncitizen (24.5)	6.0	0.3	6.8	2.5	3.1	0.1	4.2	1.8	13.6
Citizen (75.5)	24.0	3.8	15.5	5.4	12.1	1.2	7.6	1.9	20.0
Household income, \$									
Less than 30,000 (36.1)	9.3	2.4	10.3	3.9	4.6	1.4	6.1	2.4	17.5
30,001–70,000 (31.4)	23.7	3.3	14.2	5.4	12.3	0.9	6.6	1.7	19.3
More than 70,000 (32.4)	27.1	3.3	15.8	4.8	13.4	0.3	7.6	1.5	18.6
% of federal poverty level									
0–99 (21.5)	6.7	1.3	9.9	3.0	2.5	1.1	5.7	2.1	16.7
100–199 (21.0)	14.9	3.0	10.5	4.4	7.7	1.4	5.8	2.0	18.7
200–299 (14.7)	21.7	3.6	15.6	7.0	11.9	0.9	7.6	2.4	18.5
300 and higher (42.8)	27.7	3.5	15.6	4.8	13.9	0.6	7.4	1.5	19.2
Locale									
Rural (14.1)	32.8	6.8	25.9	9.9	15.6	1.4	13.5	2.7	22.7
Urban (85.9)	17.5	2.3	11.3	3.8	9.0	0.8	5.6	1.7	17.7

Note. Refusal to answer a question was uncommon; the highest frequency of refusal, 0.12%, was for whether a same-aged peer had a handgun. “Don’t know” responses also were uncommon—typically less than 2%; the single exception was the 8.3% who said that they did not know whether there was a firearm in the home of either of their 2 closest friends. Prevalence estimates were based on affirmative responses vs total responses. Weighted percentages are shown. Nearly all  $\chi^2$  tests showed statistical significance.

TABLE 3—Predictors of Firearms or Handguns: Adjusted Odds Ratios, California Adolescents

	Firearm				Handgun				
	In Home	Adolescent Has	In Friend’s Home	Friend Owns	In Home	Adolescent Has	In Friend’s Home	Friend Owns	Peer Has
Gender male (vs female)	1.22*	8.24***	2.37***	3.75***	1.61***	7.21***	2.36***	2.24**	1.73***
Age 14–17 y (vs 12–13 y)	1.42***	1.70*	1.80***	1.57*	1.49**	1.57	2.27***	1.89	3.45***
Ethnicity (vs White)									
Black	0.61*	0.42	0.76	1.61	0.57*	0.93	1.15	1.51	1.92**
Latino	0.62***	0.13**	0.61**	0.93	0.70*	0.33	0.73	2.23	1.40*
Asian	0.45***	0.40	0.44**	0.88	0.54*	0.96	0.57	2.17	1.23
Multithnic, Other	0.77	0.35**	0.90	1.04	0.82	0.23*	0.85	2.25	1.66
Citizen									
Adolescent yes (vs no)	4.55***	1.22	1.68	0.66	5.13***	0.61	1.12	0.98	1.38
Adult yes (vs no)	1.69**	3.25**	1.41	1.81	1.52	13.62**	1.30	1.48	1.49*
Employed, yes (vs no)	1.16	1.79**	1.58***	2.27***	1.29*	2.76*	1.59**	2.95**	1.47***
% of federal poverty level									
<100 (vs >300)	0.36***	1.41	1.07	0.87	0.29***	6.41**	1.12	1.39	0.96
100–199	0.67**	1.95*	0.90	1.11	0.75	5.31**	0.99	1.25	1.06
200–299	0.82	1.41	1.14	1.57	0.94	2.09	1.13	1.43	0.97
Rural locale (vs urban)	2.10***	2.34***	2.47***	2.56***	1.64***	1.23	2.40***	1.49	1.37**

\* $P < .05$ ; \*\* $P < .01$ ; \*\*\* $P < .001$ .

ing handguns: less wealthy households had lower odds of having a firearm, but adolescents from these households had higher odds of having their own handgun. Black and Latino adolescents had lower odds of reporting the presence of a firearm or handgun in the home, but higher odds of reporting that a same-aged peer had a handgun.

## DISCUSSION

A significant minority of California adolescents reported the presence of firearms in their immediate environment. Nearly one fifth (19.6%) live in a home with a firearm, and 3.0% have their own gun. Consistent with research on adults,<sup>32,33</sup> adolescents who are male or from rural areas were substantially more likely than adolescents who are female or from urban areas to report that there is a firearm in the home and that they have their own gun.

Older adolescents (compared with younger ones) had a higher adjusted odds ratio of reporting that there is a gun or handgun in their households and in the households of their 2 closest friends. This finding may indicate that as they age, adolescents become more aware of certain features of their environments. Expanding peer groups also may play a part in older adolescents’ exposure to and perceptions about firearms: although age was unrelated to whether an adolescent reported having his or her own gun or handgun, the odds ratio of knowing a same-aged peer who had a gun was higher for older adolescents.

The odds of having a gun in the home were comparable for employed and unemployed adolescents; however, employed adolescents had a higher adjusted odds ratio of believing that their close friends and same-aged peers have firearms as well as higher odds of having their own gun and their own handgun. This finding is independent of household socioeconomic status. It may be that adolescents with jobs have the resources to obtain their own guns; they may have the money with which to purchase a gun and, by fact of their employment, a larger social network that may include persons willing to supply a firearm.

There is some evidence that adolescents who are not in school are more likely to en-

odds of having a gun in the home; likewise, if the parent was a US citizen, odds were greater that the adolescent had his or her own gun.

Household poverty level was associated with whether adolescents reported a firearm in their homes or having their own guns, includ-

gage in risky behaviors,<sup>34</sup> but the hypothesis has not been adequately tested because most studies of adolescents are school based. In this community-based sample, school enrollment was not statistically significantly associated with any of the gun variables. Only 2.0% of the sample was not enrolled in school, however, which limits the power to detect differences between the groups.

Although previous research has documented an association between having a firearm in the home and risk of suicide and of homicide victimization and perpetration,<sup>35–39</sup> the risk of a fatal gunshot wound does not necessarily correspond to adolescents' reports of firearms in their immediate and proximal environments. Black and Latino adolescents in California have substantially lower odds of reporting that there is a firearm at home. In addition, compared with White adolescents, Latino adolescents have lower adjusted odds of having their own gun. However, the rate of fatal firearm injury for Latino and Black adolescents aged 10 to 19 years is 1.6 and 4.4 times, respectively, the rate for Whites of the same age.<sup>4</sup>

Adolescents who are US citizens or who have parents who are US citizens are significantly more likely than noncitizens to live in a home with a gun or handgun. Little research has focused on immigrants and firearms. There is evidence that, compared with US-born persons, young immigrants are less likely to commit suicide<sup>40</sup> but experience a disproportionate share of homicide victimization.<sup>41</sup> Immigrants and nonimmigrants appear to be equally likely to use a firearm or to be victimized with a firearm.<sup>42</sup>

Although less than 1% of California adolescents have a handgun of their own, nearly 1 in 5 (18.5%) believe that they know someone around their age who has a handgun. This discrepancy is especially marked for Black and Latino adolescents: although they did not differ from White adolescents regarding having their own handgun, Black and Latino adolescents had significantly higher odds of reporting that they knew someone their age who had a handgun. This finding may reflect reality in at least 2 ways. First, perhaps Black and Latino adolescents have a misperception about the risk posed by their peers, a misperception that may be shaped by social and media images of

youths of color. This possibility is referred to as *pluralistic ignorance*—that is, belief that one's own behavior (in this case not having a handgun) is in the minority, when in fact one is in the majority. Pluralistic ignorance is exhibited among adolescents about other health behaviors, including smoking,<sup>43</sup> drinking and drug use,<sup>44–46</sup> and sexual activity.<sup>47</sup> Evidence of pluralistic ignorance can be used in interventions emphasizing social norms. For example, in a study following a social marketing campaign, student perceptions of binge drinking norms became more aligned with actual norms, binge drinking declined, and alcohol-related injuries dropped.<sup>48–50</sup> If these findings are confirmed by subsequent research, interventions designed to change perceptions and expectations among Black and Latino adolescents about handguns among their peers could be a focus of prevention. Such intervention may be useful because belief in false norms can create imaginary peer pressure that consequently influences behavior. Second, Black and Latino adolescents, in contrast to White adolescents, may have social networks that are more likely to include persons unlike themselves. Street gangs, not uncommon among California youths, typically are comprised of traditionally underrepresented minority adolescents and young adults. As reported elsewhere,<sup>51</sup> “despite the absence of reliable data, there is broad agreement that the number and firepower of weapons available to gang members has increased.”<sup>51(p45)</sup> Thus, minority adolescents' higher odds of reporting that a same-aged peer has a handgun may be correct if they interact with or know peers who may be affiliated with a gang. Moreover, the primary reason that adolescents choose to have a handgun is the same as the reasons reported by adults—for self-protection. If self-protection is perceived as crucial in certain locales or situations, adolescents may seek to present themselves as powerful and impenetrable by conveying the impression, regardless of its accuracy, that they have a weapon.

Socioeconomic status emerged as a key consideration in these data. Although there is some evidence to support the belief that guns used in suicide and unintentional injuries among adolescents typically come from the victim's home or that of a friend or relative<sup>25</sup> (we were unable to locate research on the source of guns used by adolescents to commit

homicide), our findings indicate that access to household guns may not be the primary issue. Whereas less wealthy homes are less likely to contain a firearm, adolescents from these homes are more likely to own their own handgun. Given that the United States is among the few industrialized nations that do not report mortality or other health data by social class, we cannot assess the relationship between our findings and national mortality patterns. Moreover, it will be important from policy and intervention perspectives to determine where adolescents from poor homes get their handguns.

### Study Strengths and Limitations

CHIS is a state-of-the-art, community-based telephone survey designed to capture the diversity of California's population by oversampling particular ethnic groups, language groups, and geographic locales. Cultural review and adaptation of each survey question occurs when necessary, advance letters are sent in 5 languages to two thirds of the potential sample, financial incentives are employed, interviewers skilled in refusal conversions recontact each potential respondent who initially refuses to participate, and so forth. Nonetheless, the overall response rate for 2001, 37.7% for adult respondents (59.7% of potential respondents completed the screening questions and 64.7% of these people completed the interview itself), was not optimal. Participation rates in telephone surveys have dropped substantially in the past few decades,<sup>52</sup> and the decrease appears to have accelerated in recent years. For example, response rates in the Behavior Risk Factor Surveillance System dropped from a median of 68.4% in 1995 to a median of 55.2% in 1999; 18 states had participation rates below 50% in 1999.<sup>53</sup> Although research on response rates has focused primarily on respondent refusal, the inaccessibility of potential respondents is a growing concern. There has been only a slight increase in disconnected and business numbers in random-digit-dialed samples but a significant increase in the number of “no answer” and “busy” dispositions, even after multiple attempts.<sup>54</sup> As noted elsewhere,<sup>55</sup> the proliferation of telephone numbers dedicated exclusively to fax machines or computers, of nondedicated

phone lines to connect to the Internet, and the use of call screening devices (e.g., caller ID and call blocking, the latter of which prevents a call from ringing through) present major obstacles to reaching a potential respondent. Telephone response rates are generally believed to be lower in California, whose consumer privacy legislation has been a model for legislation elsewhere.

In addition, the required double layer of permission to participate reduces response rates in studies of adolescents. In the current study, 63.5% of the adult parents or guardians gave permission for their adolescent to be interviewed, and 84.5% of the permitted adolescents agreed to be interviewed, resulting in a response rate of 53.7%, which is in line with recent Behavior Risk Factor Surveillance System response rates. If, however, one takes into account the overall adult response rate, the adolescent response rate drops further. The assumption that the participating and nonparticipating adults were equally likely to have an adolescent in the home cannot be tested; therefore, the true response rate cannot be ascertained. Despite these problems, the unweighted data for the sample are roughly comparable to US Census data on key variables (e.g., age, gender, income). In addition, sample and population weights were used, which theoretically can correct for potential weaknesses in a sample.

The data share the limitations of all self-report data, and responses were not externally corroborated. For some sense of response validity, we reviewed other surveys of California adolescents. The California Student Survey, a legislatively mandated survey of seventh-, ninth-, and 11th-grade students from a representative sample of public and private secondary schools in California, provides perhaps the best comparison data.<sup>56</sup> In general, a lower proportion of CHIS respondents than of California Student Survey respondents reported smoking cigarettes, drinking alcohol, or using drugs.

If responses to questions about firearms are consistent with responses to questions about other risk-related behaviors, these data may be biased toward conservative estimates. Moreover, the active permission processes used in this study (i.e., parents must consent for their children to participate) typically results in a more law-abiding sample of adoles-

cents.<sup>57–59</sup> The patterns in the data probably are more robust than the point estimates.

## CONCLUSIONS

Findings indicate that gun-related risk often attributed to ethnicity may more correctly be attributed to socioeconomic status. The handguns of poor adolescents and, in particular, the source of these guns, given that these adolescents' households are less likely to contain a gun, merit attention, especially as the proportion of the US population living in poverty is increasing.<sup>60</sup> Further research is needed to assess the accuracy of minority adolescents' beliefs about their peers and handguns. ■

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### Contributors

S.B. Sorenson conceived the study, secured funding, helped develop the questions, supervised data analysis, and wrote the article. K.A. Vittes conducted data analysis and helped write and edit the article.

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### Human Participant Protection

The University of California Los Angeles Human Subjects Protection Committee reviewed and approved this study.

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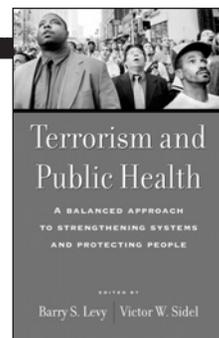
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# Can Better Mental Health Services Reduce the Risk of Juvenile Justice System Involvement?

E. Michael Foster, PhD, Amir Qaseem, MD, PhD, MHA, and Tim Connor, MS

Current research on youths treated in US public mental health systems reveals that many have been or will be involved in the juvenile justice system (E.M. Foster and T. Connor, unpublished data, 2002).<sup>1,2</sup> Other research suggests that the obverse is also true: many youths in the juvenile justice system suffer from mental health problems.<sup>3-6</sup> While these conditions may have been preexisting, entry into the juvenile justice system probably exacerbates them. Many observers fear that time spent in juvenile justice residential facilities further traumatizes these young people and only worsens their mental health problems.<sup>7</sup> Such findings suggest that keeping youths with emotional and behavioral problems out of the juvenile justice system should be a public health priority.

The overlap between the juvenile justice and mental health systems raises difficult questions surrounding service delivery to the children and youths straddling the 2 systems. One strategy for addressing these issues involves integration of and coordination between the mental health and juvenile justice systems. Such system-level coordination and collaboration is the focus of the so-called “system of care” approach to the delivery of mental health services, an approach that reflects a public health perspective on mental health problems.

Under a system of care, responsibility for meeting the mental health needs of children and youths resides at the community level rather than with a single agency. Various child-serving agencies, such as mental health and juvenile justice, coordinate and integrate service delivery. Such collaboration can involve strategic planning, interagency budgeting and cost sharing, implementation of comprehensive screening and assessment, case management, and cross-training of staff.<sup>8</sup>

When implemented, systems of care also involve changes in the types of mental health services delivered. These changes

**Objectives.** We evaluated how improved mental health services affect justice involvement among juveniles treated in the public mental health system.

**Methods.** Our analyses were based on administrative and interview data collected in 2 communities participating in the evaluation of a national initiative designed to improve mental health services for children and youths.

**Results.** Results derived from Cox proportional hazard models suggested that better mental health services reduced the risks of initial and subsequent juvenile justice involvement by 31% and 28%, respectively. Effects were somewhat more pronounced for serious offenses.

**Conclusions.** Our findings suggest that improved mental health services reduce the risk of juvenile justice involvement. (*Am J Public Health.* 2004;94:859–865)

generally increase the use of community-based alternatives (e.g., day treatment or partial hospitalization) to restrictive inpatient hospitalization, and they can involve services, such as multisystemic therapy,<sup>9-17</sup> targeted specifically to young people with a history of serious delinquency.

Taken together, these elements of the system of care work to reduce juvenile justice involvement. As a result of system integration, youths with emotional and behavioral problems who break the law or engage in other offenses may have their problems identified more quickly and may be diverted into the mental health system. By targeting underlying mental health problems (such as aggression), mental health services may reduce the likelihood of a subsequent offense and contact with the juvenile justice system.

At present, little research exists on how systems of care affect juvenile justice involvement. One possible basis for such research is the Comprehensive Community Mental Health Services for Children and Their Families Program (the “Children’s Program”) funded by the Substance Abuse and Mental Health Services Administration. This program is fostering public sector systems of care throughout the country.

In several of the communities involved in the Children’s Program, juvenile justice is well integrated within the system of care. In Stark

County (Canton), Ohio, for example, juvenile justice is integrated with the system of care at several levels: program administration, financing, service delivery, and training for juvenile justice personnel. Administratively, the system of care operates under the aegis of the Stark County Family Council,<sup>18</sup> whose board of trustees includes a juvenile justice official. The council administers pooled funds contributed by multiple child-serving agencies, including juvenile justice.

At the level of service delivery, the target population for the system of care comprises youths who are at risk of out-of-home placement and who are involved in multiple child-serving sectors, including juvenile justice. Furthermore, there is a cross-system service planning process in which juvenile justice personnel can participate, and mental health staff are stationed at juvenile justice facilities. Finally, the mental health agency provides juvenile justice personnel with training in mental health issues (e.g., principles of multisystemic therapy).

Stark County and 66 other communities are participating in an evaluation of the Children’s Program. This evaluation comprises both quantitative and qualitative elements; the former includes a longitudinal study of the children and youths served at each site. As a means of providing a group of comparison children and youths, 3 system-of-care

sites were matched with comparison communities. One pair involves the Stark County system and a comparison site in Mahoning County (Youngstown), Ohio. Using data from these sites, we examined whether the system of care can eliminate or delay involvement in juvenile justice among youths receiving mental health services. Our analyses employed hazard models to examine the timing of first involvement with the juvenile justice system and the likelihood of recidivism. Analyses incorporated prestudy differences in demographic characteristics and risk of juvenile justice involvement.

## METHODS

Since 1994, the Center for Mental Health Services (CMHS) within the US Department of Health and Human Services has funded the development of systems of care through the Children's Program. The CMHS program provides communities with seed money to establish a system of care administrative structure. Communities draw on Medicaid, block grants, and other sources to actually fund services.

### Design of Comparison Pairs Study

CMHS also has funded a national, multi-site evaluation. This evaluation, which provided the data for the present study, included a quasi-experimental study matching and comparing 3 system-of-care communities with 3 similar communities. As just described, 1 pair involved 2 Ohio communities. As part of the evaluation, a sample of 449 children and adolescents aged 6 to 17 years who had serious emotional and behavioral problems and were using mental health services were recruited for a longitudinal study. Study enrollment began in September 1997 and continued through October 1999, with follow-up data collection continuing through December 2000.

In the case of most of the study children and adolescents, entry into the study coincided with entry into the mental health service system. According to the core service data described subsequently, fewer than 1 in 4 participants had received mental health services more than 90 days before study entry. Among youths who had received services in

**TABLE 1—Descriptive Sample Statistics, by Ohio County**

	Mahoning County			Stark County			P <sup>a</sup>
	No. of Observations	Mean or %	SD	No. of Observations	Mean or %	SD	
Child age, y	216	11.51	3.27	232	11.13	3.10	.21
Female, %	216	31	0.46	232	35	0.48	.33
Household income, \$ (100s)	215	137.67	119.89	229	178.06	157.63	<b>.00</b>
Race/ethnicity, %							
Hispanic	216	8	0.28	231	1	0.11	<b>.00</b>
African American	216	53	0.50	232	29	0.46	<b>.00</b>
Mental health status							
Symptomatology (CBCL)	215	70.17	9.69	232	68.93	9.48	.17
Functioning (CAFAS)	215	78.09	24.64	227	70.75	25.45	<b>.00</b>
Family structure, %							
Caregiver married	215	25	0.43	232	29	0.46	.27
Parent in household	215	82	0.38	229	80	0.40	.52
Grandparent in household	215	11	0.31	229	10	0.30	.70
Caregiver education (omitted category: caregiver some college), %	215			232			
High school dropout		49	0.50		58	0.50	
High school diploma		17	0.38		15	0.35	.17
Some college		34	0.47		28	0.45	
Caregiver employment (omitted category: not working), %	213			232			
Not working		57	0.50		49	0.50	
Employed part time		20	0.40		18	0.39	.18
Employed full time		23	0.42		33	0.47	
Child educational status, %							
Receiving failing grades	212	37	0.48	228	32	0.47	.21
Repeated a grade	215	42	0.49	231	42	0.49	.98
Currently not in school	216	1	0.10	232	1	0.09	.94

Note. CBCL = Child Behavior Checklist; CAFAS = Child and Adolescent Functional Assessment Scale.

<sup>a</sup>P values pertain to the null hypothesis of no between-site difference. Values less than .05 are shown in boldface.

the past, therefore, entry into the study coincided with a new episode of care.

### Data Source and Study Samples

*Interview data.* Data on youths' mental health status and family demographic characteristics were collected through face-to-face interviews conducted with caregivers and their children. Interviews were conducted at study entry and then at subsequent 6-month intervals. A comparison of baseline demographic characteristics revealed that the children enrolled in the study were relatively similar across the 2 communities (Table 1). Participants did differ, however, in regard to race/ethnicity and family income. Children in the system of care community were less likely

to be African American and to have a family income of more than \$15 000 per year. Other family characteristics, such as caregiver education and employment, were similar between the communities.

The caregiver interviews incorporated well-accepted measures of child mental health, such as the Child and Adolescent Functional Assessment Scale (CAFAS) and the Child Behavior Checklist (CBCL). The CAFAS assesses child functioning in 8 domains, while the CBCL assesses behavioral symptoms. As with the demographic data, these measures revealed both similarities and differences among the children in the 2 communities (Table 1). The participants had similar levels of overall clinical symptoms at intake (CBCL),

**TABLE 2—Involvement in the Juvenile Justice System in Ohio, by County**

	Mahoning County		Stark County		<i>P</i> <sup>a</sup>
	No. of Observations	Mean or %	No. of Observations	Mean or %	
Ever involved in juvenile justice, %	217	47	232	39	.08
Characteristics among those involved in juvenile justice during study period					
Average age at first <sup>b</sup> offense	103	13.17	91	13.27	.75
First offense occurred after study entry, %	103	83	91	77	.25
First offense serious, <sup>c</sup> %	103	50	91	57	.29

<sup>a</sup>*P* values pertain to the null hypothesis of no between-site difference.

<sup>b</sup>First offense refers to the first offense occurring during the 1997–2000 period (see text for discussion).

<sup>c</sup>Serious offenses are those that involve violent crimes, property crimes, alcohol and drug offenses, weapons offenses, criminal damaging and trespassing, and sexual offenses.

but children in the comparison community had higher levels of functional impairment (CAFAS).

**Management information system data.** The participating mental health centers in the 2 communities are behavioral health treatment organizations. Core mental health service data were derived from each agency's management information system, which is used for billing purposes. Services included in the data obtained from both communities were as follows: intake and assessment, case management, medication monitoring, and individual and group counseling. The system of care also offered day treatment, and the alternative system operated a short-term crisis residential center.

**Data regarding juvenile justice involvement.** To assess study participants' contact with juvenile justice systems, we extracted data from management information systems maintained by juvenile courts in the 2 communities for the years 1997 through 2000. The juvenile courts maintain current and historical information on all juvenile offenses, including offense type, date of court referral, adjudication, and disposition. A wide range of offenses are recorded in each management information system, examples being violent crimes, property crimes, criminal trespassing, disorderly conduct, alcohol- and drug-related offenses, weapons-related offenses, truancy and curfew violations, and probation violations.

Both official and unofficial cases are included in the management information sys-

tem data. Official cases funnel juveniles through the entire court process, including a court hearing, adjudication, and a final disposition. Unofficial cases involve actual offenses, but the cases are handled informally through agreements involving the youth's parents, a judge, and a probation officer.

These data allowed us to examine the timing of first and subsequent offenses and to differentiate offenses as "serious" or other. Serious offenses involve violent crimes, property crimes, alcohol and drug offenses, weapons offenses, criminal damaging and trespassing, and sexual offenses. Because some offenses may have occurred before the period for which juvenile justice data were available, the first and subsequent offenses may have represented the first and subsequent offenses that occurred during the 1997 to 2000 period only. However, this situation probably applied to a relatively small portion of the sample. Seventy-five percent of the participants were 12 years or younger at the beginning of the data collection period (more than half [55%] were 10 years or younger).

### Hazard Model

Because they incorporate key data features, hazard (or event history) models were appropriate for our analysis of timing in regard to juvenile justice involvement.<sup>19–21</sup> In particular, a hazard analysis incorporates the fact that participants in a given study enter and exit the observation period at different ages. In addition, such an analysis reflects the fact that the experiences of some individuals are "cen-

sored" (in the present case, the timing of future offenses was unknown). Furthermore, hazard analyses allowed us to incorporate the fact that youths entered this study in the midst of the risk period. Hazard analyses can incorporate study entry accurately by treating study participation as a time-varying covariate. This allowed the risk of juvenile justice involvement to rise or fall after study entry.

Hazard models can be implemented in several forms. We used the Cox proportional hazards model. A major advantage of this semiparametric model is that it does not impose a specific functional form for the baseline hazard profile (or the risk profile across age). The model does allow for the hazard to be shifted up or down by covariates. The resulting parameter estimates are best exponentiated and interpreted as hazard ratios (in the present case, the proportional effects of covariates on the risk of juvenile justice involvement). A hazard ratio greater or less than 1 corresponds to a characteristic that raises or lowers the risk of involvement.

The analyses described subsequently included a range of covariates. Our focus here is on 3 of these covariates: a site indicator, a "pre–post" indicator pertaining to study entry, and an interaction between these 2 factors. The first covariate captured between-site differences among participants before study entry. We interpreted preexisting between-site differences in juvenile justice involvement as reflecting differences between sites in regard to (1) underlying risk factors and (2) mental health referral patterns. (Even though the system of care was in place throughout the period, we did not interpret preentry differences as reflective of the system of care per se because the individuals involved were generally not receiving mental health services.) The second key covariate captured the difference in risk before and after study entry (and often into mental health services) for the comparison site. The interaction term captured the effect of interest: the between-site difference in the effect of study entry.

We also included a range of child and family characteristics as covariates (enumerated in Table 1 and described subsequently). Although only a handful of these characteristics exhibited between-site differences, we included them in the analyses to improve

**TABLE 3—Predictors of Juvenile Justice Involvement, by Number and Type of Offenses**

Predictor	Statistic	First Offenses		Second Offenses	
		All	Serious	All	Serious
Site (Stark County = 1; Mahoning County = 0)	Hazard ratio	1.26	1.30	1.21	1.20
	SE	0.27	0.33	0.33	0.55
	t statistic	1.08	1.06	0.70	0.39
Time (poststudy entry = 1)	Hazard ratio	0.78	0.95	0.78	1.42
	SE	0.26	0.36	0.27	0.59
	t statistic	-0.75	-0.15	-0.71	0.84
Time × Site interaction	Hazard ratio	0.58	0.46	0.64	0.32
	SE	0.19	0.17	0.26	0.18
	t statistic	-1.68	<b>-2.11</b>	-1.11	<b>-2.03</b>
Covariate					
Child age	Hazard ratio	0.91	0.96	1.14	1.15
	SE	0.10	0.11	0.17	0.21
	t statistic	-0.82	-0.38	0.88	0.75
Gender (female)	Hazard ratio	0.55	0.45	0.83	0.35
	SE	0.10	0.09	0.19	0.11
	t statistic	<b>-3.34</b>	<b>-4.04</b>	-0.81	<b>-3.27</b>
Household income	Hazard ratio	1.00	1.00	1.00	1.00
	SE	0.00	0.00	0.00	0.00
	t statistic	-0.40	0.03	-0.68	-1.26
Race/ethnicity					
Hispanic	Hazard ratio	1.63	1.02	1.11	1.64
	SE	0.54	0.45	0.47	0.94
	t statistic	1.47	0.04	0.25	0.86
African American	Hazard ratio	1.51	1.39	1.16	1.30
	SE	0.29	0.29	0.27	0.39
	t statistic	<b>2.18</b>	1.59	0.62	0.86
Mental health status					
Symptomatology	Hazard ratio	1.01	0.99	1.02	1.05
	SE	0.01	0.01	0.01	0.02
	t statistic	0.67	-0.68	1.07	<b>2.39</b>
Functioning	Hazard ratio	1.00	1.00	1.00	0.99
	SE	0.00	0.00	0.01	0.01
	t statistic	0.08	0.01	-0.46	-0.90
Family structure					
Caregiver married	Hazard ratio	0.98	1.00	1.23	1.86
	SE	0.18	0.21	0.30	0.69
	t statistic	-0.11	0.02	0.87	1.68
Parent in household	Hazard ratio	1.50	1.49	0.56	0.94
	SE	0.46	0.58	0.16	0.51
	t statistic	1.32	1.03	<b>-2.02</b>	-0.11
Grandparent in household	Hazard ratio	1.07	1.18	0.53	0.78
	SE	0.43	0.60	0.25	0.66
	t statistic	0.17	0.33	-1.35	-0.29
Caregiver education (dummy coded; omitted category: care giver some college)					
High school dropout	Hazard ratio	0.57	0.63	0.87	1.05
	SE	0.11	0.14	0.22	0.30
	t statistic	<b>-2.82</b>	<b>-2.08</b>	-0.56	0.19

Continued

and ensure between-site comparability. Stata<sup>22</sup> software was used in calculating all parameter estimates.

**RESULTS**

Tables 1 through 3 and Figure 1 present the results of our analyses. Table 1 describes the sample in terms of demographic and mental health characteristics. On average, the study children were 11 years of age at baseline, and the majority were male. Given that the children were being treated in public systems, socioeconomic status was low. Family incomes averaged less than \$20 000 at the 2 sites. Roughly half of the caregivers were high school dropouts (49% and 58% in Mahoning and Stark counties, respectively); only a minority were working full time. Most of the children lived with a single parent. (Roughly 80% of the households in which youths resided included a parent. In most of these households [approximately 70%], the caregiver was not married.)

As one would expect, the youths involved in the study were struggling. At baseline, 42% reported having repeated a grade (Table 1); roughly 1 in 3 reported receiving failing grades. Furthermore, juvenile justice involvement was common (Table 2): 47% and 39% of the Mahoning and Stark county youths, respectively, were involved in the juvenile justice system during the course of the study. The average age at which these youths first encountered the juvenile justice system was 13 years. A majority first entered the juvenile justice system after study entry: 83% and 77% in Mahoning and Stark counties, respectively. This difference was not statistically significant; however, the fact that more youths had preentry contact with the juvenile justice system in Stark (23%) than in Mahoning (17%) probably reflected the integration of the mental health and juvenile justice systems in the former. Table 2 also provides basic data on offense severity. At both sites, 50% or more of first offenses were serious.

Figure 1 presents the key findings from the hazard analyses. (The full results are described subsequently and presented in Table 3.) The first 2 pairs of bars represent the risk of juvenile justice involvement after study entry relative to the prestudy period.

TABLE 3—Continued

Completed high school	Hazard ratio	0.65	0.64	0.89	0.96
	SE	0.17	0.19	0.27	0.41
	<i>t</i> statistic	-1.68	-1.52	-0.37	-0.09
Caregiver employment (dummy coded; omitted category: not working)					
Caregiver employed part time	Hazard ratio	0.99	1.24	1.50	2.14
	SE	0.24	0.32	0.44	0.78
	<i>t</i> statistic	-0.05	0.84	1.36	<b>2.09</b>
Caregiver employed full time	Hazard ratio	1.19	1.18	1.30	2.64
	SE	0.23	0.27	0.31	0.86
	<i>t</i> statistic	0.89	0.72	1.09	<b>2.98</b>
Child educational status					
Receiving failing grades	Hazard ratio	1.32	1.39	1.82	0.97
	SE	0.24	0.28	0.42	0.26
	<i>t</i> statistic	1.51	1.62	<b>2.57</b>	-0.10
Repeated a grade	Hazard ratio	1.08	0.96	1.12	1.62
	SE	0.19	0.20	0.27	0.49
	<i>t</i> statistic	0.41	-0.18	0.47	1.58
Not in school	Hazard ratio	7.37	3.87	1.70	3.82
	SE	3.40	1.65	0.85	2.49
	<i>t</i> statistic	<b>4.32</b>	<b>3.18</b>	1.06	<b>2.06</b>
Previous juvenile justice involvement					
Age at first offense	Hazard ratio	... <sup>a</sup>	... <sup>a</sup>	1.00	1.00
	SE	... <sup>a</sup>	... <sup>a</sup>	0.00	0.00
	<i>t</i> statistic	... <sup>a</sup>	... <sup>a</sup>	<b>2.17</b>	0.53
Whether first offense was "severe"	Hazard ratio	... <sup>a</sup>	... <sup>a</sup>	0.68	... <sup>b</sup>
	SE	... <sup>a</sup>	... <sup>a</sup>	0.14	... <sup>b</sup>
	<i>t</i> statistic	... <sup>a</sup>	... <sup>a</sup>	-1.83	... <sup>b</sup>
No. of observations		420	420	227 <sup>c</sup>	186 <sup>d</sup>

Note. Covariates significant at the .05 level are shown in boldface.

<sup>a</sup>These covariates are not included here because the analyses focused on the first offense.

<sup>b</sup>This covariate is not included here because the first offense that defined the at-risk period for a subsequent offense was limited to the severe offense category.

<sup>c</sup>These analyses were limited to individuals who committed an initial offense.

<sup>d</sup>These analyses were limited to individuals who committed an initial serious offense.

At both sites, the risk of initial juvenile justice involvement dropped after study entry. This decrease was greater in Stark County (-54%) than in Mahoning County (-22%). (We calculated these figures using the hazard ratios described subsequently. For example, the second bar, representing the 22% risk reduction in Mahoning after study entry, pertained to a time variable hazard ratio of 0.78. The figure for Stark corresponded to the product of the hazard ratio for the time variable [0.78] and the Time × Site interaction [0.58], which was 0.46. This hazard ratio implied a 54% reduction in risk. The significance level of the

between-site difference was that associated with the Time × Site interaction.)

The between-site difference was significant at a marginal level ( $P=.09$ ). However, in the case of serious crimes the between-site difference was substantially greater and statistically significant ( $P=.03$ ). While the likelihood of youths committing a serious crime after study entry remained largely unchanged in Mahoning, this likelihood dropped by 57% in Stark.

The second 2 pairs of bars represent recidivism, or the likelihood of the occurrence of a second offense. These analyses were limited to youths who had committed a first offense.

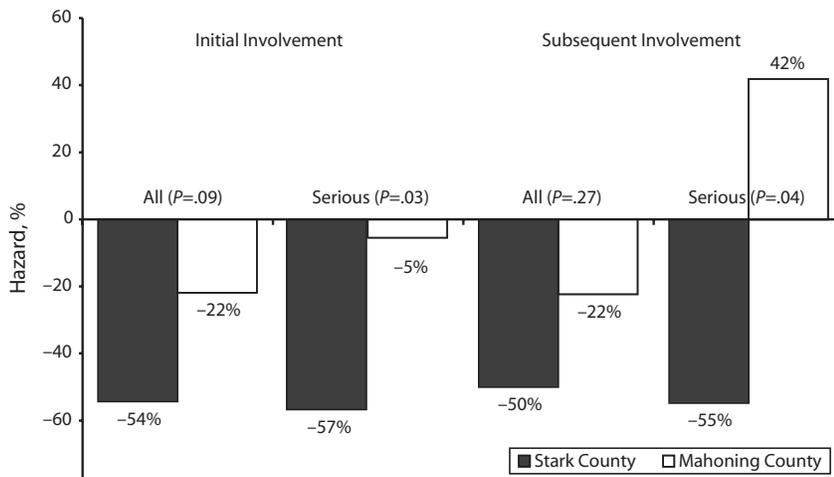
A similar pattern emerged for offenses of all types. Hazard ratios fell after study entry at both sites, with a greater reduction occurring in Stark. The between-site difference in regard to serious crimes was especially large. The risk of a second, serious offense actually increased after study entry in Mahoning.

The full set of results is presented in Table 3, which includes hazard ratios for all of the covariates assessed. It can be seen in the first column that the hazard ratio for site was greater than 1 (1.26), indicating that children in Stark County were at greater risk of juvenile justice involvement before study entry. As discussed earlier, this difference was expected given the system of care philosophy; interagency coordination should result in the juvenile justice system referring more children into services. The hazard ratio for time was less than 1 (0.78), indicating a reduction in risk after study entry. Finally, the interaction term was also less than 1 (0.58), indicating a greater reduction over time in Stark County.

Table 3 also includes hazard ratios for the child and demographic characteristics described earlier. Results showed that female youths were 45% less likely than male youths to be involved in the juvenile justice system (column 1; hazard ratio=0.55). In addition, non-White youths were 51% more likely than White youths to be involved (hazard ratio of 1.51). The effect of the covariates did vary somewhat across outcomes. For example, receipt of failing grades at baseline was associated with higher hazard ratios for all covariates other than recidivism in regard to serious crimes (the effect was greatest [and statistically significant] for the risk of recidivism).

## DISCUSSION

This study examined the impact of coordinated and integrated mental health services on juvenile justice involvement among youths served in the public mental health system. Using data from a quasi-experiment, we assessed between-site differences using hazard models. As mentioned, these models were well suited to addressing the research question of interest here because they can accommodate key data features, principally, in the present case, the fact that youths entered the study (and mental health services) during the



**FIGURE 1—Risk of juvenile justice involvement: hazard analysis results.**

midst of the period in which they were at risk for involvement in the juvenile justice system.

While previous research has examined the mental health needs of youths involved in the juvenile justice system, relatively little attention has been focused on whether system integration can reduce such involvement. Our results were derived from only 2 communities and are subject to other limitations, but they suggest that community-based care coordinated across child-serving agencies can reduce or delay entry into the juvenile justice system as well as recidivism among those who have been involved in the system. These relationships were stronger for more serious offenses.

Our study also links juvenile justice involvement to a range of other youth and family characteristics. The relationships we found were generally consistent with those revealed in other research. We found, for example, that juvenile justice involvement is more likely for boys and for non-White youths. Also, youths who are struggling in school tend to have a higher risk of involvement. However, there were some surprising relationships as well. For example, youths living with a grandparent were more likely to be involved in the juvenile justice system. In this case, causality could have been reversed: the youth's behavior may have led to the grandparent moving into the household.

Although provocative, our results are subject to several limitations. Principal among these limitations are possible between-site differences in children and youths receiving mental health services. Youths in Stark County may have been less likely to become involved in the juvenile justice system for reasons not captured here. This possibility is counterintuitive, however: the system of care there attempted to draw youths involved in the juvenile justice system into the mental health system. If anything, one would expect youths in Stark to have been otherwise *more* likely to become involved in the juvenile justice system; thus, our results may be conservative.

In any case, we did adjust between-site comparisons with a variety of baseline characteristics, including mental health symptomatology and functioning. Furthermore, our analyses incorporated information on juvenile justice involvement before study entry. Nevertheless, the results presented here should be interpreted as preliminary, and they require replication in other communities and with other study designs (perhaps including randomization).

An important question for future research is whether a public health-oriented strategy of avoiding juvenile justice placements among youths with emotional and behavioral problems is cost-effective. A full economic analysis would depend on how the costs of identifying and treating the mental health problems of a

large group of at-risk youths compare with those related to detaining a subset of such individuals in the future. The answer to this question awaits future research. ■

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### Contributors

E.M. Foster conceived the study and was responsible for all analyses and for writing the article. A. Qaseem assisted in the analyses and in preparation of the article. T. Connor assisted in preparation of the article.

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### Human Participant Protection

This study, which involved analyses of secondary data, was approved by the Pennsylvania State University office for research protections. The original study was approved by the Office of Management and Budget and the institutional review board of ORC Macro Inc. All study participants signed informed consent forms.

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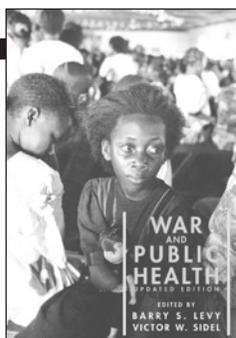
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# Overcoming Language Barriers in Health Care: Costs and Benefits of Interpreter Services

Elizabeth A. Jacobs, MD, MPP, Donald S. Shepard, PhD, MPP, Jose A. Suaya, MD, MBA, and Esta-Lee Stone, MS, OTR/L

More than 46 million people in the United States do not speak English as their primary language, and more than 21 million speak English less than “very well.”<sup>1</sup> Persons who have limited English proficiency are less likely to have a regular source of primary care<sup>2,3</sup> and are less likely to receive preventive care.<sup>2,4,5</sup> They also are less satisfied with the care that they do receive,<sup>6,7</sup> are more likely to report overall problems with care,<sup>7</sup> and may be at increased risk of experiencing medical errors.<sup>8</sup>

Because most health care organizations provide either inadequate interpreter services or no services at all,<sup>9–14</sup> patients who have limited English proficiency do not receive needed health care or quality health care. Often, persons enlisted to help patients communicate with health care providers are not trained interpreters; instead, they are fellow patients or are family members, friends, untrained nonclinical employees, or nonfluent health care professionals.<sup>6–8</sup> Reliance on such ad hoc services has been shown to have negative clinical consequences.<sup>15–18</sup>

Many health care providers do not provide adequate interpreter services because of the financial burden such services impose.<sup>19,20</sup> However, these providers fail to take into account both the consequences of not providing the services and the potential cost benefits of improving communication with their patients. The failure of health care providers to consider these issues is at least partially attributable to the paucity of data documenting the full costs and benefits of interpreter services. To acquire a better understanding of these costs and benefits, we assessed the impact of implementing a new interpreter service program on the cost and utilization of health care services among patients with limited English proficiency.

## METHODS

The study setting and sample have been described extensively elsewhere.<sup>21</sup> Briefly,

**Objectives.** We assessed the impact of interpreter services on the cost and the utilization of health care services among patients with limited English proficiency.

**Methods.** We measured the change in delivery and cost of care provided to patients enrolled in a health maintenance organization before and after interpreter services were implemented.

**Results.** Compared with English-speaking patients, patients who used the interpreter services received significantly more recommended preventive services, made more office visits, and had more prescriptions written and filled. The estimated cost of providing interpreter services was \$279 per person per year.

**Conclusions.** Providing interpreter services is a financially viable method for enhancing delivery of health care to patients with limited English proficiency. (*Am J Public Health.* 2004;94:866–869)

the study was conducted from June 1, 1995, through May 31, 1997, at 4 health centers serving approximately 122 000 patients. These health centers were staffed by salaried physicians (“staff model”) and were part of a large Massachusetts health maintenance organization (HMO) that implemented comprehensive interpreter services for Spanish- and Portuguese-speaking patients on June 1, 1995 (beginning of year 2 of the study). The services were provided by 5 full-time trained interpreters who were available to help patients 24 hours a day either by telephone or during walk-in visits and at all points of contact in the HMO.

HMO members were eligible for the study if they were at least 18 years old at the beginning of the study and were continuously enrolled in 1 of the 4 centers that had the new interpreter services. Eligible members who used the interpreter services at least once during year 2 of the study constituted the interpreter service group. A random sample of 10% of all other eligible members who had accessed care at 1 of the 4 centers at least once during year 2 of the study formed the comparison group. The comparison group was used to control for secular trends in use of health care services that were independent of the implementation of interpreter services.

The data abstracted from the automated medical record system included demographic information and information about utilization of preventive, primary care, and emergency department services. For preventive services, our measure was the percentage of recommended services (appropriate for age and gender) received each year by each person. Measures of primary care utilization included annual number of health center office visits and phone calls, urgent care visits and phone calls, and prescriptions written and filled.

Cost data included both the direct costs of providing interpreter services and the costs of net changes in health care utilization that occurred after the new services were implemented. Direct costs included interpreter salaries, fringe benefits, and overhead costs. The cost allocated to each health care service delivered before and after the new services were implemented was the average Medicaid fee-for-service payment in Massachusetts during the 2 years of the study. We used the costs to the Massachusetts Division of Medical Assistance to provide this organization with information about the impact of interpreter services on the cost of care for Massachusetts patients with limited English proficiency. The estimated net cost of medical interpretation per person per year in the interpreter service group included the cost of

interpretation plus the net change in costs of health care utilization.

We compared receipt of preventive services, primary care, and hospital-based care and the cost of that care before and after adequate interpreter services were implemented. We compared changes in the interpreter service group with those in the comparison group by calculating the net mean difference (the change in the interpretive service group minus the change in the comparison group) and by modeling this difference in a linear regression model with the within-person difference as the outcome variable. (Within-person differences reflect the change in utilization and the cost of care for each person in the study both before and after implementation of the interpreter services.) In this manner, differences in absolute level of services or costs between the 2 groups attributable to measured or unmeasured characteristics were controlled.<sup>22</sup>

## RESULTS

There were 380 patients in the interpreter service group and 4119 in the comparison group. The majority of interpreter service group patients spoke Spanish ( $n=300$ ). Compared with the comparison group, the interpreter service group had more females (63% vs 57%); the patients were older (mean age  $45 \pm 14$  years vs  $42 \pm 14$  years) and lived in zip codes with lower median incomes. We adjusted for these differences in the regression analyses. Mean years of enrollment were similar between the 2 groups.

### Utilization of Care

Relative to the comparison group, the interpreter service group showed significantly greater increases per person per year in the following services: percentage of the recommended preventive services received (7.3% vs 2.7%;  $P=0.033$ ), number of office visits made (1.74 vs 0.71;  $P=0.014$ ), and number of prescriptions written (1.70 vs 0.52;  $P=0.001$ ) and filled (2.38 vs 0.88;  $P<0.001$ ). Use of the emergency department was rare among both groups. Although the interpreter service group experienced a net reduction in emergency department visits per person per year relative to the comparison group ( $-0.04$

**TABLE 1—Costs of Clinical Service During Year 1 and Change in Cost From Year 1 to Year 2<sup>a</sup>**

Service	Interpreter Services Group (n = 380)		Comparison Group (n = 4119)		Net Difference <sup>b</sup>
	Year 1, \$	Year 2 - Year 1, \$	Year 1, \$	Year 2 - Year 1, \$	
Preventive	14	1	11	1	0
Primary care	405	99	387	43	56**
Emergency department	31	-6	38	5	-11
Total costs	450	94	436	49	45*

<sup>a</sup>Reported as total cost per person per year in each category of service use.

<sup>b</sup>(Year 2 - Year 1 in the interpreter service group) - (Year 2 - Year 1 in the comparison group).

\* $P<.05$ ; \*\* $P<.01$ .

**TABLE 2—Net Change in Cost per Person in the Interpreter Service Group During Year 2**

	Unit Cost, \$	No. of Visits <sup>a</sup>	Cost, \$	Cost, %
Interpretation service	79.43	2.95	234	84
Change in health care utilization			45	16
Net change in costs			279	100

<sup>a</sup>Total number of visit-days per person in the interpreter service group during year 2.

vs 0.02), this change was not statistically significant ( $P=0.24$ ).

### Cost of Care and Interpreter Services

Preventive services, primary care, and total costs increased among both groups between years 1 and 2 of the study, and emergency department costs increased among the comparison group and decreased among the interpreter service group (Table 1). The increase in the cost of providing primary care was greater for the interpreter service group than for the comparison group and resulted in a significantly greater increase in the overall cost of care for the interpreter service group. The cost of providing 1 year of interpreter services for Spanish- and Portuguese-speaking patients was \$245 363 and 3089 documented interpretations were performed in the second year of the study, with an average cost of \$79 per documented interpretation. The estimated total cost per person (among the interpreter service group) of providing interpreter services was \$279 (Table 2), the sum of the average cost of interpretation (\$234) plus the average increase in cost of care (\$45) per person. The average cost for the total number of enrollees

in the 4 health centers was \$2.40 per HMO member per year.

## DISCUSSION

We found that providing professional interpreter services in a large staff-model HMO increased delivery of health care to patients with limited English proficiency. We also found that the majority of the increase in cost of care was attributable to the provision of interpreter services. Patients who used the new interpreter services had significant increases in the receipt of preventive services, physician visits, and prescription drugs, which suggests that interpreter services enhanced these patients' access to primary and preventive care for a moderate increase in cost.

We consider this cost to be reasonable in the context of reimbursement costs for other types of care during 1995–1997. For example, annual Medicaid expenditures in 1996 for persons with mood disorder, diabetes, or heart disease were \$1957, \$1563, and \$2328, respectively.<sup>23</sup> Compared with these Medicaid expenditures, the expenditure of \$279 per person per year for interpreter services was

reasonable, especially because interpretation improved patients' utilization of preventive and primary care services, such as follow-up visits and medications, that potentially may reduce costly complications of these and other conditions. The statistically significant increase in receipt of preventive services also suggests that improving language access for patients who have limited English proficiency may lower the cost of care in the long run.

Several limitations should be considered in interpreting our findings. First, the sample size of the interpreter service group was small and may not have provided sufficient power for detection of some effects. Second, we abstracted data for only 1 year after the new interpreter services were implemented, possibly too short a time to fully assess the impact of the new services. Third, the data did not measure all of the potential benefits of these services, such as improved communication and quality of care. Likewise, the measures of health care utilization in our study did not capture all of the potential costs or cost benefits to insurers that may result from providing interpreter services. For example, interpreters may impact utilization of physician time or diagnostic testing which could either increase or decrease costs to the insurer. Conflicting evidence exists regarding whether or not the presence of an interpreter increases expenditure of physician time<sup>24,25</sup>; however, some evidence suggests that the ordering of laboratory tests is reduced when interpreters are present, thus reducing costs.<sup>24</sup> Including data on such potential costs and cost benefits in our study may have had the effect of reducing our net cost of implementation of interpreter services.

The study setting also may have affected our findings. The study was conducted at a well-established staff-model HMO with enrollees who were continuously insured for an average of more than 3 years. These services may have had a different impact on a patient population in a different health system or a patient population with less familiarity with, or less access to, a health care system. On the other hand, use of hospital services in the HMO was well below national averages, so savings could be greater in other settings. The cost estimates reflect the perspective of a single insurer and would likely be higher if

calculated from a private insurer's perspective. The costs measured in our study reflect the costs of hiring staff interpreters in a large health care system." The costs of providing interpreter services via outside agencies or via telephone would likely differ.

Finally, we know from national data that the cost per interpretation in our study was excessively high. The average length of interpreter time per documented encounter was 2.55 hours, compared with about 1 hour in established programs. It appears that the interpreters were underused either because the number of full-time interpreters needed at the start of the program was overestimated or because providers were not aware of the new services and thus did not use them when needed. The costs of most interpreter services programs are more reasonable (about \$35 per interpretation vs \$79 in our study) than represented in our study.<sup>26</sup>

Despite these limitations, our research has important clinical and policy implications. Patients who have limited English proficiency need to be able to communicate adequately with their health care providers if access to health care is to improve for this large and growing US population. While this fact seems obvious, millions of patients are denied adequate care every day because they do not speak English or do not speak English well. Both policymakers and health care providers are unaware of how interpretation services may benefit providers and their patients, and providers are reluctant to shoulder costs for which they are not reimbursed. Better data is needed to allow them to make more informed choices, and providers need reimbursement from insurers such as Medicaid for the provision of interpreter services. ■

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#### Contributors

E. A. Jacobs was primarily responsible for writing the article and, along with D. S. Shepard, conceptualized the study. D. S. Shepard and J. A. Suaya contributed to both the analysis of the data and the writing of the article. E.-L. Stone oversaw the conceptualization and the implementation of the study plan and critically reviewed the article.

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**Note.** The views expressed in this article are those of the authors and are not necessarily those of the sponsors or the institutions involved in this study.

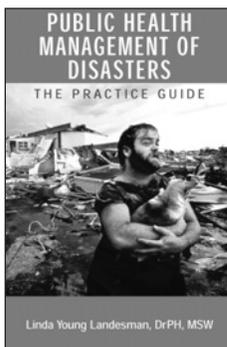
#### Human Participant Protection

The study was approved by the human studies committee of Harvard Pilgrim Health Care.

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# Vitamin C Deficiency and Depletion in the United States: The Third National Health and Nutrition Examination Survey, 1988 to 1994

Jeffrey S Hampl, PhD, RD, Christopher A. Taylor, PhD, RD, and Carol S. Johnston, PhD, RD

Health professionals in the United States generally consider overt vitamin C deficiency, or scurvy, to be a disease of historical significance.<sup>1</sup> Despite numerous case studies in the recent medical literature,<sup>2–19</sup> scurvy is now presumed to be an uncommon disease in developed nations,<sup>20</sup> and patients who present with low-grade inflammation, fatigue, limping, gum bleeding, or swollen extremities may not be screened for vitamin C deficiency.<sup>15,17,21,22</sup> Furthermore, because the signs and symptoms of scurvy are similar to those of other conditions (e.g., vasculitis, rheumatic disorders, reduced lung function), patients with vitamin C deficiency initially may be misdiagnosed and prescribed medication without receiving proper therapy.<sup>17,23</sup>

In the United States, mean vitamin C intakes usually exceed the recommended dietary allowances (RDAs) of 75 and 90 mg per day for women and men, respectively.<sup>24</sup> Elevated mean intakes, however, mask the fact that numerous US residents underconsume vitamin C. Data from the US Department of Agriculture's 1994 to 1996 Continuing Survey of Food Intakes by Individuals showed that 18% of US adults consumed less than 30 mg per day of vitamin C, despite an overall mean intake of 95 mg per day.<sup>25</sup> The data from this survey further indicated that 14% of male and 20% of female 13- to 18-year-olds consumed less than 30 mg per day of vitamin C (RDAs are 65 and 75 mg per day for girls and boys, respectively).<sup>26</sup>

In addition to low dietary intakes, numerous reports have indicated that cigarette smokers are at increased risk of low serum vitamin C owing to the free-radical-quenching role of vitamin C (i.e., the ability to render oxidants harmless),<sup>27–29</sup> and the most recent data from the 2000 Behavioral Risk Factor Surveillance System indicate that 23% of US adults smoke cigarettes.<sup>30</sup> At the same time,

**Objectives.** We sought to determine prevalence rates of vitamin C deficiency and depletion in the United States.

**Methods.** We used data from the Third National Health and Nutrition Examination Survey to assess intake of dietary, supplemental, and serum vitamin C.

**Results.** Mean intakes and serum levels of vitamin C were normal; however, vitamin C deficiency and depletion were common (occurring among 5%–17% and 13%–23% of respondents, respectively). Smokers, those who did not use supplements, and non-Hispanic Black males had elevated risks of vitamin C deficiency, while Mexican Americans had lower risks.

**Conclusions.** Health professionals should recommend consumption of vegetables and fruits rich in vitamin C and should recommend supplementation for individuals at risk of vitamin C deficiency. (*Am J Public Health.* 2004;94:870–875)

most Americans are not consuming the recommended number of servings of vegetables and fruits or taking vitamin supplements.<sup>20,31</sup> Currently, the second leading cause of death in the United States is cancer; as a preventive measure, high vitamin C intakes may reduce the risk of oral, esophageal, stomach, and breast cancers.<sup>20</sup> Serum vitamin C levels have been assessed in international studies,<sup>32–34</sup> but little is known regarding vitamin C status among American children and adults. The present study was conducted to determine the prevalence of vitamin C deficiency and depletion in the United States.

## METHODS

The National Center for Health Statistics conducted the Third National Health and Nutrition Examination Survey (NHANES III) to assess the health status of children and adults in the United States. In this cross-sectional survey, personal household information was collected and health examinations conducted with 30 818 individuals 2 months and older; household interviews were conducted over a 6-year period (1988–1994). Adults 60 years or older, non-Hispanic Blacks, and Mexican Americans were purposively oversampled to produce

more precise estimates for these population groups. Detailed descriptions of the plan and operation of the survey, including informed consent, have been reported previously.<sup>35</sup>

The sample for this study (n = 15 769) included civilian, noninstitutionalized children and adults aged 12 to 74 years. Data regarding demographic characteristics, socioeconomic status, dietary habits, and health history were collected during the household interview. In addition, self-reported race/ethnicity was recorded during the household interview and coded as non-Hispanic White, non-Hispanic Black, or Mexican American.

Quantitative dietary data were collected via 24-hour dietary recalls during the clinic examination, and results were coded with the US Department of Agriculture nutrient database (included with the NHANES III CD-ROM).<sup>36</sup> Respondents were queried regarding the supplements they used and how many times they had taken each supplement during the preceding month. As a means of estimating vitamin C intakes from supplements, a monthly total was calculated and then divided by 30 to derive daily supplemental vitamin C intake (as described by Will et al.<sup>37</sup>). Physical examinations, including venipunctures, were conducted in mobile examination centers ap-

proximately 2 to 4 weeks after household interviews. Overall, NHANES III response rates were 86% for the household interview and 78% for the physical examination.<sup>35</sup>

Participants were asked to fast overnight before arriving in the morning at the mobile examination center for assessment. Serum vitamin C was measured at the Centers for Disease Control and Prevention in Atlanta via isocratic high-performance liquid chromatography with electrochemical detection.<sup>38</sup> The coefficient of variation for the vitamin C assay averaged 5.8%.<sup>38</sup> (The term *vitamin C* was defined as comprising all compounds that exhibit the activity of ascorbic acid, including dehydroascorbic acid reduced during analysis.) Serum vitamin C levels, ranging from 0.0  $\mu\text{mol/L}$  to the upper cutoff point of 170  $\mu\text{mol/L}$ , were categorized according to internationally established limits: deficiency (less than 11  $\mu\text{mol/L}$ ), depletion (11–28  $\mu\text{mol/L}$ ), or normal (more than 28  $\mu\text{mol/L}$ ).<sup>33,39,40</sup> Several participants ( $n=21$ ) were excluded from analyses because their serum vitamin C levels were quite high (more than 170  $\mu\text{mol/L}$ ) and of dubious validity.

Respondents 17 years and older were questioned about tobacco use on 2 separate occasions. As part of the household interview, respondents who reported that they had smoked at least 100 cigarettes in their lifetime were asked whether they currently smoked cigarettes. During the private interview conducted in the mobile examination center, all respondents—including those who had not reported any tobacco use in the household interview—were questioned about their use of cigarettes during the past 5 days.

The NHANES III CD-ROM is equipped with the Statistical Export and Tabulation System (SETS), which we used to export data into SPSS 10.0 (SPSS Inc, Chicago, Ill) for data reduction. We conducted all analyses using SPSS and SUDAAN (version 7.5; Research Triangle Institute, Research Triangle Park, NC), which is a statistical program that takes into account the NHANES sampling weights and the survey's complex design. We used sample weights, based on probability of selection, to adjust for nonresponse; weights were poststratified to the US Bureau of Census 1990 estimates of the total US population.

**TABLE 1—Mean ( $\pm$  SEM) Vitamin C Intakes and Serum Vitamin C Levels**

Gender and Age, y	No.	Population Size <sup>a</sup>	Dietary Vitamin C, mg	Total Vitamin C, <sup>b</sup> mg	Serum Vitamin C, $\mu\text{mol/L}$
<b>Male</b>					
12–17	975	9.59	117 $\pm$ 5	145 $\pm$ 7	46.0 $\pm$ 1.7
18–24	1011	11.00	125 $\pm$ 6	179 $\pm$ 16	36.9 $\pm$ 1.1
25–44	2649	36.53	119 $\pm$ 4	202 $\pm$ 14	36.3 $\pm$ 1.1
45–64	1765	20.39	110 $\pm$ 4	210 $\pm$ 16	38.0 $\pm$ 1.1
65–74	955	7.61	118 $\pm$ 5	194 $\pm$ 9	44.9 $\pm$ 1.1
<b>Female</b>					
12–17	1133	9.14	101 $\pm$ 5	145 $\pm$ 23	50.0 $\pm$ 1.7
18–24	1186	12.04	102 $\pm$ 5	159 $\pm$ 6	43.7 $\pm$ 1.7
25–44	3212	37.66	91 $\pm$ 2	164 $\pm$ 5	42.6 $\pm$ 1.1
45–64	1916	22.05	97 $\pm$ 4	206 $\pm$ 11	47.7 $\pm$ 1.1
65–74	967	8.95	107 $\pm$ 3	198 $\pm$ 10	55.1 $\pm$ 1.1

<sup>a</sup>In millions, using weights obtained from NHANES III.

<sup>b</sup>Dietary vitamin C plus supplements.

To improve the normality of the distributions of dietary and serum vitamin C, we log-transformed data before conducting statistical analyses. We assessed data using tabulation to document vitamin C deficiency and depletion. We used odds ratios (ORs) and 95% confidence intervals (CIs) to estimate relative prevalence rates of vitamin C deficiency, with serum vitamin C levels below 11  $\mu\text{mol/L}$  as a cutoff. We used Pearson's correlation coefficient to assess the relationship between total vitamin C intakes and serum vitamin C. In the case of all tests, we considered 2-tailed  $P$  values less than .05 to be statistically significant.

## RESULTS

Mean dietary intakes and serum levels of vitamin C were within normal ranges, as indicated in Table 1. In the case of all age groups, mean vitamin C intakes from diet alone exceeded the RDA, ranging from 110 to 125 mg per day for males and 91 to 107 mg per day for females. Supplemental vitamin C resulted in mean total vitamin C intakes being even higher, ranging from 145 to 210 mg per day for males and 145 to 206 mg per day for females. Mean serum vitamin C levels ranged from 36.3 to 46.0  $\mu\text{mol/L}$  and 42.6 to 55.1  $\mu\text{mol/L}$  for males and females, respectively. As shown in Figure 1, total vitamin C intakes from diet and supplements

were linearly related to serum vitamin C levels among both males ( $r=0.41$ ,  $P<.0001$ ) and females ( $r=0.42$ ,  $P<.0001$ ) across all age groups.

Table 2 shows that, overall, 14% of males and 10% of females were vitamin C deficient, as indicated by serum vitamin C values. The percentages of 12- to 17-year-old males and females who were vitamin C deficient were low (5%–6%) relative to other groups. Among all age groups, the percentage of males with vitamin C deficiency was greater than that of females, reaching a peak of 17% among 25- to 64-year-olds. Among females, the greatest prevalence (12%) of vitamin C deficiency was found among 25- to 44-year-olds.

Across all age groups, proportionately more males and females exhibited vitamin C depletion than vitamin C deficiency. Among males, rates of vitamin C depletion ranged from 15% among 65- to 74-year-olds to 23% among 25- to 44-year-olds. Among females, the lowest rate of vitamin C depletion (13%) was found among 65- to 74-year-olds, and the highest rate (20%) was found among 25- to 44-year-olds.

Table 3 lists odds ratios related to risk of vitamin C deficiency. As a group, current smokers had the highest risk of vitamin C deficiency. The odds ratio of vitamin C deficiency among smokers was high in the case

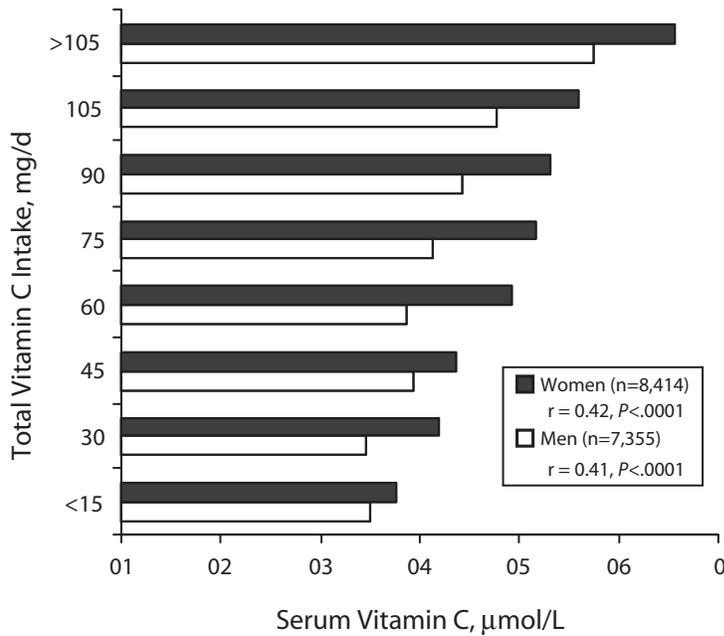


FIGURE 1—Mean vitamin C intakes, stratified by serum vitamin C levels.

TABLE 2—Percentages of Vitamin C Deficiency, Depletion, and Normal Serum Values Among US Males and Females

Gender and Age, y	Serum Vitamin C Value		
	<11 $\mu\text{mol/L}$ , %	11–28 $\mu\text{mol/L}$ , %	>28 $\mu\text{mol/L}$ , %
<b>Male</b>			
12–17 (n=975)	6	17	77
18–24 (n=1011)	13	22	65
25–44 (n=2649)	17	23	60
45–64 (n=1765)	17	20	63
65–74 (n=955)	11	15	74
Overall	14	20	66
<b>Female</b>			
12–17 (n=1133)	5	15	80
18–24 (n=1186)	11	19	70
25–44 (n=3212)	12	20	68
45–64 (n=1916)	10	15	75
65–74 (n=967)	6	13	81
Overall	10	17	73

of both males (OR=3.6; 95% CI=3.2, 4.1) and females (OR=4.2; 95% CI=3.6, 4.9). Both males (OR=3.3; 95% CI=2.8, 4.0) and females (OR=3.1; 95% CI=2.6, 3.7) who had not used nutrient supplements in the past month had an increased risk of vitamin C deficiency. Non-Hispanic Black males had a

slightly increased risk of vitamin C deficiency (OR=1.2; 95% CI=1.1, 1.5) relative to White males, while Mexican American males (OR=0.83; 95% CI=0.71, 0.97) and females (OR=0.80; 95% CI=0.66, 0.96) both had a lower risk of vitamin C deficiency than White males and females.

DISCUSSION

These nationwide data indicate that a considerable number of US residents are vitamin C deficient or depleted. Although our findings are contrary to the accepted notion that vitamin C status in the United States is within normal limits, previous work corroborates these data. Dickinson et al.<sup>41</sup> assessed NHANES II (in which data were collected from 1976 to 1980) and reported that vitamin C depletion occurred in up to 25% of nonsmoking men and up to 50% of adult male smokers. In smaller, more recent studies, Johnston and colleagues<sup>42,43</sup> reported vitamin C depletion in approximately 21% of university students (n=98) and 30% of outpatients presenting to a local health maintenance organization laboratory (n=494). Johnston et al.<sup>42</sup> further reported that 6.3% of their outpatient sample had plasma ascorbic acid concentrations indicative of vitamin C deficiency.

We found moderately strong correlations ( $r=0.41$  and  $r=0.42$  for men and women, respectively) between total vitamin C intakes and serum vitamin C levels, as did Loria et al.<sup>40</sup> using NHANES II data ( $r=0.54$ ) and Sinha et al.<sup>44</sup> ( $r=0.56$ ) in a case-control study. These values are higher than that reported by Drewnowski et al.<sup>45</sup> for the correlation between serum vitamin C and total vegetable and fruit intakes ( $r=0.29$ ). In that study, however, use of supplemental vitamin C was not reported. Measuring supplemental vitamin C is of crucial importance in analyses because total vitamin C intakes and serum vitamin C have an S-shaped relationship. When intakes exceed 70 mg per day, excess vitamin C is excreted in the urine, causing the correlation to flatten off as vitamin C intakes increase.<sup>46</sup>

Consistent with data reported from NHANES II,<sup>40</sup> our data showed that elderly US residents (aged 65 years or older) had a lower prevalence of vitamin C deficiency and depletion than members of other adult age groups. These results differ from those of Bates et al.,<sup>47</sup> who found that 33% of their sample of community-dwelling British adults 65 years or older (n=1310) consumed less than the United Kingdom's reference nutrient intake<sup>48</sup> for vitamin C. Bates et al.<sup>47</sup> further reported that 14% of their

**TABLE 3—Effects of Smoking, Supplement Use, and Ethnicity on Vitamin C Deficiency**

	Serum Vitamin C Value		Odds Ratio (95% Confidence Interval)
	<11 $\mu\text{mol/L}$ , %	$\geq 11$ $\mu\text{mol/L}$ , %	
<b>Male</b>			
Smoking status			
Nonsmokers (n = 4429)	11	89	1.0
Smokers (n = 2115)	31	69	3.6 (3.2, 4.1)
Supplement use			
Yes (n = 2119)	7	93	1.0
No (n = 5226)	20	80	3.3 (2.8, 4.0)
Race/ethnicity			
Non-Hispanic White (n = 2613)	16	84	1.0
Non-Hispanic Black (n = 2115)	19	81	1.2 (1.1, 1.5)
Mexican American (n = 2346)	13	87	0.83 (0.71, 0.97)
<b>Female</b>			
Smoking status			
Nonsmokers (n = 5776)	7	93	1.0
Smokers (n = 1686)	25	75	4.2 (3.6, 4.9)
Supplement use			
Yes (n = 3204)	5	95	1.0
No (n = 5204)	14	86	3.1 (2.6, 3.7)
Race/ethnicity			
Non-Hispanic White (n = 3039)	11	89	1.0
Non-Hispanic Black (n = 2605)	13	87	1.2 (1.0, 1.4)
Mexican American (n = 2379)	9	91	0.80 (0.66, 0.96)

sample had plasma vitamin C levels below 11  $\mu\text{mol/L}$ , indicative of vitamin C deficiency. In the same study, 40% of elderly individuals residing in nursing homes or residential homes (n = 423) had plasma vitamin C levels below 11  $\mu\text{mol/L}$ , with a mean level of 24.4  $\mu\text{mol/L}$ .<sup>47</sup>

Seniors are more likely than individuals in other age groups to purchase and use nutrient supplements,<sup>49–52</sup> and vitamin C consistently ranks as one of the most frequently purchased supplements.<sup>40</sup> Previous research has shown that consumption of vitamin C supplements results in a doubling of total vitamin C intake,<sup>44,46</sup> and we showed that individuals who had not used supplements in the previous month had a greatly increased risk of vitamin C deficiency (odds ratios of 3.3 and 3.1 for males and females, respectively). Furthermore, McKay et al.<sup>50</sup> noted that supplementation with 250 mg of vitamin C for 8 weeks resulted in a 29% increase in plasma concentrations of vitamin C in a group of community-dwelling, healthy seniors. For

many years, physicians, dietitians, and other health professionals have hesitated to discuss supplementation with patients, partly to avoid implying that supplements can substitute for a healthy eating plan; however, this paradigm may be changing. Recently, Fletcher and Fairfield<sup>53</sup> recommended that all US adults take a multivitamin every day to reduce their risk of chronic disease, and additional dialogue is needed to determine appropriate levels of supplementation.

In the United States, individuals who take supplements are least likely to need them,<sup>44</sup> and several studies have noted that cigarette smokers are unlikely to purchase supplements.<sup>29,54</sup> We showed that cigarette smokers had a high risk of vitamin C deficiency (odds ratios of 3.6 and 4.2 among male and female smokers, respectively). Vitamin C is a strong reducing agent (i.e., an electron donor), both in vivo and in vitro, and the lower level of serum vitamin C reported among smokers probably is caused by higher turnover of vitamin C owing to its antioxidant activity.<sup>55,56</sup>

The Food and Nutrition Board of the National Academy of Sciences recommends that individuals who smoke consume an additional 35 mg of vitamin C per day (110 and 125 mg per day for adult females and males, respectively).<sup>24</sup> In all likelihood, this additional vitamin C is not sufficient to combat the oxidative damage that results from cigarette smoking. High intakes of vitamin C, as achieved by supplementation, may be appropriate for smokers, especially those who do not consume ample servings of vegetables and fruits rich in vitamin C.

Race/ethnicity-specific data regarding vitamin C status are sparse, but our data showed that non-Hispanic Black males had a slightly increased risk of vitamin C deficiency (OR = 1.2). In cross-sectional studies, Koh et al.<sup>57</sup> and Loria et al.<sup>40</sup> reported that plasma ascorbic acid levels were significantly lower among Black than White residents of the United States, while Ness et al.<sup>32</sup> reported that London residents of Caribbean or West African descent had lower levels of plasma vitamin C than did Whites. These lower serum levels seem to be the result of poorer dietary intakes<sup>40</sup> rather than any genetic differences in vitamin C absorption or use.

Furthermore, Vitolins et al.<sup>52</sup> reported that Black residents of the United States were significantly ( $P = .001$ ) less likely to use supplements than were Whites or Native Americans. In comparison with non-Hispanic Blacks, we showed that Mexican American males and females had significantly lower risks of vitamin C deficiency (OR = 0.83 and OR = 0.80, respectively). Because it involves common consumption of chiles, tomatoes, and squashes, the traditional Mexican diet is rich in vitamin C and other nutrients.<sup>58</sup> However, Mexican Americans are at increased risk of chronic diseases related to hypertension, overweight, and type 2 diabetes, and thus further research is warranted to better understand food availability, eating habits, and disease outcomes in this population.<sup>59–61</sup>

Internationally, vitamin C deficiency is frequently observed when vegetable and fruit intakes are limited as a result of lack of availability, high prices, and poor storage capacity.<sup>33</sup> One would not assume vitamin C deficiency to be common in America, given the variety of US diets; however, Chiplonkar

et al.<sup>34</sup> reported that the prevalence of vitamin C deficiency among Western Indian adults was quite similar to what we reported here for the United States. Vegetables and fruits serve as primary contributors to total vitamin C intake,<sup>10,42,48</sup> and although numerous Americans are meeting the National Cancer Institute's "5-a-day" goal for vegetables and fruits,<sup>62</sup> many of the vegetables and fruits typically consumed are not good sources of vitamin C. The leading vegetables and fruits consumed in the United States—in descending order of consumption—are iceberg lettuce, raw tomatoes, french fries, bananas, and orange juice, representing nearly 30% of all vegetables and fruits consumed by US adults<sup>25,31</sup>; of these foods, however, only orange juice is a rich source of vitamin C. Broccoli, strawberries, kale, and grapefruit all are rich sources of vitamin C, but, combined, they represent less than 2% of all vegetable and fruit consumption in the United States.<sup>31</sup>

The amount of vitamin C in any particular food may differ considerably from what is listed in a nutrient database or food label. Vitamin C—the least stable of the vitamins—is readily destroyed by exposure to air,<sup>48</sup> and degradation is accelerated further by exposure to heat, alkali, and metals.<sup>63</sup> In fact, normal cooking of vegetables and fruits can reduce their vitamin C content by 20% to 40%.<sup>10</sup> Johnston and Bowling<sup>64</sup> assessed vitamin C oxidation in orange juice and found that the amount of ascorbic acid per 8 fl oz (240 mL) dropped as the expiration date approached, with a decomposition rate of approximately 2% ascorbic acid per day once the container of juice was opened.

One limitation of the present study was that our measure of vitamin C status was based on a single blood sample. Because vitamin C is water soluble and is not stored for a long period of time in body tissues, a single measurement of vitamin C may indicate only an individual's short-term (1–4 weeks) vitamin C status. Although single 24-hour dietary recalls do not fully describe a given individual's eating habits, the 1-day recall method applied to a large population is more effective than more complex and expensive methods when the goal is to determine group means.<sup>65</sup> In addition, all large-scale nutrition surveys have the

potential for underestimating food and nutrient intakes. In the present case, however, the 24-hour dietary recalls were administered via standardized, computerized probes; edited carefully for completeness; and verified to determine the accuracy of extreme values.<sup>35</sup> Trained study staff, whose performance was monitored routinely, completed the dietary interviews in private rooms, and nearly all (95%) of the participants provided 24-hour dietary recalls. For these reasons, we believe that our dietary data provide a relatively complete assessment of vitamin C intakes.

In conclusion, our data indicate that a considerable number of children and adults in the United States are vitamin C deficient or depleted. Health professionals should continue to recommend consumption of vegetables and fruits, especially those that are rich in vitamin C. In addition, vitamin C supplementation should be discussed with all patients, but especially those who are at the greatest risk of vitamin C deficiency: cigarette smokers and poor eaters. ■

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#### Contributors

J.S. Hampl drafted the article, and C.A. Taylor and C.S. Johnston contributed to critical revisions of the article. J.S. Hampl and C.A. Taylor were responsible for acquisition of the data. All of the authors were involved with the study's conception and design and the analysis of data.

#### Human Participant Protection

No protocol approval was needed for this study.

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# Highway Repair: A New Silicosis Threat

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The United States is currently engaged in a massive public works effort to repair the national highway system's deteriorating infrastructure.<sup>1,2</sup> The Federal Highway Administration and state transportation agencies are responsible for improvements to the national highway system and its support roads. The national highway system is composed of 163 000 miles of rural and urban roads and includes the interstate system, other urban and rural principal arteries, and strategic highway network connectors. The Transportation Equity Act for the 21st Century (TEA-21) was enacted on June 9, 1998, and is the latest in a series of legislation that authorizes federal surface transportation programs for highways, highway safety, and transit.<sup>3</sup>

Because the interstate system is nearly completed, the focus has shifted from constructing new highways to preserving and improving existing highways. Much of the pavement on the interstate system was constructed 20 to 40 years ago, with some older highways having been incorporated into the system. Data on interstate pavement condition are taken from the Highway Performance Monitoring System (HPMS) and are used to track the condition and the performance of US highway systems. The 1994 HPMS report to Congress (the most recent) showed that more than half of the highway system's pavement was rated as fair to poor, indicating a need for resurfacing or other rehabilitation in the near future.<sup>4</sup>

Traditional methods of highway surface repair involved patching damaged areas with asphalt, an approach that usually resulted in failure within months of the repair. In the mid-1980s, a new method of cut-and-repair road maintenance that uses newly developed quick-setting concrete material, resulted in more permanent repairs. This new method utilizes large crews to cut, break up, and remove large sections of concrete road before patching begins. These operations, sometimes completed during overnight work shifts, result in the generation of large amounts of dust.

**Objectives.** We describe an emerging public health concern regarding silicosis in the fast-growing highway repair industry.

**Methods.** We examined highway construction trends, silicosis surveillance case data, and environmental exposure data to evaluate the risk of silicosis among highway repair workers. We reviewed silicosis case data from the construction industry in 3 states that have silicosis registries, and we conducted environmental monitoring for silica at highway repair work sites.

**Results.** Our findings indicate that a large population of highway workers is at risk of developing silicosis from exposure to crystalline silica.

**Conclusions.** Exposure control methods, medical screenings, protective health standards, and safety-related contract language are necessary for preventing future occupational disease problems among highway repair workers. (*Am J Public Health.* 2004;94:876–880)

Our article describes the potential risk of silicosis for workers in the fast-growing highway repair industry. We reviewed silicosis surveillance data from the National Institute for Occupational Safety and Health (NIOSH) Sentinel Event Notification System for Occupational Risks (SENSOR) and crystalline silica exposure data from highway repair projects collected during the 1999 road construction season.

## Background

Silicosis is a disabling, nonreversible, and sometimes fatal lung disease caused by inhaling dust containing extremely fine particles of crystalline silica.<sup>5,6</sup> Crystalline silica is found in materials such as concrete, masonry, and rock. Working with materials that contain crystalline silica can produce airborne respirable dust, causing lung damage. Silicosis is a disease with a long latency period and usually takes 20 years or more to develop. Symptoms of silicosis include shortness of breath, wheezing, chest tightness, and cough, although initially there may be no symptoms. In addition to causing silicosis, inhalation of crystalline silica particles has been associated with other diseases, such as chronic obstructive pulmonary disease, connective tissue disease, renal disease, tuberculosis, and lung cancer.

The dangers of silica exposure and silicosis are well established in the mining,<sup>7–9</sup> iron and steel manufacturing,<sup>10,11</sup> and pottery industries.<sup>12–14</sup> The danger to construction workers

is less clear, although certain occupations (e.g., masonry, abrasive blasting) have well-documented associations with silicosis.<sup>15–19</sup> Since 1985, silicosis surveillance has been conducted in several states under the NIOSH SENSOR program.<sup>20</sup> The New Jersey Department of Health and Senior Services (NJDHSS) is 1 of 3 state agencies that conduct surveillance of silicosis under SENSOR (Michigan and Ohio are the other 2 states). The SENSOR states obtain reports of silicosis from hospital discharge data, physician records, death certificates, and other sources.<sup>21</sup> Recently, California, New York, Maine, New Mexico, and North Carolina have begun silicosis surveillance under various NIOSH surveillance grants.

The NJDHSS maintains a registry of reported silicosis cases and collects the medical and occupational data necessary for determining whether a case meets an epidemiological case definition. Cumulative data on silicosis are collected and are analyzed by NIOSH to determine incidence, causes, and trends of the disease. An integral component of the New Jersey surveillance system for silicosis is the follow-up of work sites identified through case reports. NJDHSS industrial hygienists conduct on-site evaluations, assess the risk of exposure to silica, and recommend control measures to prevent exposure.

The NJDHSS began a hazard surveillance project in 1998 to investigate highway repair as a possible source of silica exposure. Interest

**TABLE 1—Participants in the New Jersey Silica Partnership**

NJ Dept of Health and Senior Services
NJ Dept of Transportation
NJ Dept of Labor, OSHA Onsite Consultation Service
Federal Dept of Labor, OSHA
NIOSH, Division of Respiratory Disease Studies
NIOSH, Division of Engineering Control Technology
Utility and Transportation Contractors Association
Association of General Contractors
Laborers' Health and Safety Fund of North America
Laborers' International Union, Locals 172 and 472
NJ State Safety Council
Ten different highway construction contractors

Note. OSHA = Occupational Safety and Health Administration; NIOSH = National Institute for Occupational Safety and Health.

in this industry stemmed from a sentinel case of silicosis identified by NJDHSS in 1993. The case involved an individual who worked for 2 road construction companies from 1955 to 1990. This person was 63 years old when he was first diagnosed with silicosis. His work history indicated exposure to silica dust without respirator use during highway-building activities. Although the sentinel case pointed to exposure as a result of building roads versus repairing highways, a link between the highway construction industry and silica exposure was established. A review of the Occupational Safety and Health Administration's (OSHA) Integrated Management Information System database revealed that few data were available on silica exposure from highway construction. A pilot project was initiated with the New Jersey Department of Transportation (NJDOT) to perform industrial hygiene air sampling at highway repair sites. Air sampling was performed at a bridge deck repair site during the 1998 summer construction season; levels of silica dust indicated that workers were potentially overexposed.

In January 1999, the New Jersey Silica Partnership (Table 1) was formed to address issues associated with silica exposure among New Jersey road and highway workers. The primary goal of this effort was to quantify silica exposure from dust-producing tasks undertaken during road construction and repair work. The silica exposure data were used to support the

development of protective language for NJDOT contracts similar to the health and safety language for reducing lead exposure that currently appears in NJDOT contracts for overpass- and bridge-painting operations.

## METHODS

The materials used to build roads, such as concrete, asphalt, and masonry products, contain silica sand as well as other types of crystalline silica. Road construction and repair workers are potentially exposed to airborne silica dust from activities that create airborne dust, such as sawing, breaking, and grinding concrete and other materials that contain silica.

We reviewed all confirmed silicosis cases from the New Jersey, Michigan, and Ohio silicosis registries containing work histories coded with construction Standard Industrial Classification (SIC) codes<sup>22</sup> for SENSOR case reports from 1993–1997. In addition to identifying the workplace associated with each case, we collected data on occupation, age at diagnosis, year of first exposure, and duration of exposure. We reviewed case data to determine whether a link could be established between highway and road construction and silicosis.

In April 1999, NJDHSS industrial hygienists began a 6-month effort to collect air-sampling data for various tasks performed in road construction and repair. A protocol was developed and was distributed to 10 contractors who had been awarded highway repair contracts from the NJDOT. Personal samples of respirable crystalline silica dust were collected at a flow rate of 1.7 L/min with a battery-operated sampling pump. The pump was attached to the employee's waist and was connected via Tygon tubing to a preweighted 37-mm, 5- $\mu$ m pore-size polyvinyl chloride filter in a filter cassette; a 10-mm Dorr-Oliver nylon cyclone was placed in the employee's breathing zone in accordance with NIOSH method 7500.<sup>23</sup> Samples were analyzed by an OSHA-accredited laboratory in accordance with OSHA method ID-142.<sup>24</sup>

At each worksite survey, workers involved in specific highway repair tasks were selected for silica air sampling. These dust-producing tasks were targeted after discussions with the contractors and the industrial hygienist's visual observation of dust generated from the various tasks during the initial survey. Eight-hour time-

weighted-average sample results were compared with exposure standards established by OSHA and the American Conference of Industrial Hygienists (ACGIH) for crystalline silica. The OSHA permissible exposure limit (PEL) varies from 0.1 mg of respirable dust per cubic meter of air (mg/m<sup>3</sup>) to almost 5 mg/m<sup>3</sup> depending on the percentage of crystalline silica in the dust. In 2000, the ACGIH adopted a threshold limit value (TLV) of 0.05 mg/m<sup>3</sup> for respirable crystalline silica.<sup>25</sup> The 0.05 mg/m<sup>3</sup> level is equal to the recommended exposure limit (REL) established by NIOSH in 1974.<sup>26</sup>

## RESULTS

### Surveillance Case Data

Five hundred seventy-six confirmed silicosis cases in New Jersey, Michigan, and Ohio were reported to NIOSH for the years 1993 through 1997. Silicosis cases were identified by first determining potential silica exposure from the work history; then confirmation was obtained through either a positive chest x-ray reading for silicosis by a NIOSH certified "B reader" or a medical record radiology report with findings consistent with silicosis.<sup>27</sup> Work history data indicated 45 (8%) of the confirmed cases resulted from work in the construction industry under SIC codes 15, 16, and 17. Twelve (27%) of the construction cases were coded under SIC 16, "heavy construction other than building construction." SIC 16 includes road, bridge, tunnel, elevated-highway, water, sewer, and utility line construction. SIC 16 also includes miscellaneous heavy construction, such as dam, power plant, marine, and golf course construction. Highway repair contractors are usually small, multitask companies that engage in a wide range of construction activities.

Industry, occupation, age at diagnosis, year of first exposure, and duration of exposure for silicosis case reports under SIC 16 are shown in Table 2. Five of the 12 SIC 16 cases (42%) involved work in tunnel construction. Three cases (25%) specifically identified road construction and maintenance as the primary source of exposure. The New Jersey road-construction case indicated new-highway construction in which exposure began in the 1950s, well before the introduction of the modern cut-and-patch repair method. Case 1 in Ohio occurred in a laborer with an 8-year

**TABLE 2—Highway Construction Silicosis Case Data—New Jersey, Michigan, Ohio: 1993–1997**

Construction Type (SIC 16)	Occupation	Age at Diagnosis, y	Year of First Exposure	Duration of Exposure, y
<b>New Jersey</b>				
Road	Maintenance	63	1955	34
Tunnel	Laborer	75	1946	11
Tunnel	Driller	65	1928	23
Tunnel	Sandhog <sup>a</sup>	49	1938	...
Tunnel	Welder	...	...	...
Tunnel	Sandhog	61	1969	18
<b>Michigan</b>				
Heavy	Truck driver	...	1970	24
Heavy	Equipment operator	...	1976	8
Sewer	Laborer/sandblaster	...	1954	27
<b>Ohio</b>				
Road	Laborer	37	...	8
Road	Maintenance	...	...	...
Sewer	Laborer	80	1958	15

Note. SIC 16 = Standard Industrial Classification (SIC) code 16: heavy construction other than building construction.  
<sup>a</sup>Tunnel worker.

duration of work involving the use of a jackhammer on bridge surfaces, although no information was provided about when exposure occurred. Road maintenance was listed as the occupation on the death certificate for case 2 in Ohio but no data were provided on year of first exposure or duration of exposure. Two cases in Michigan potentially involved road construction; again, however, the work histories were incomplete.

**Air-Monitoring Data**

Monitoring for airborne crystalline silica was completed for 9 highway repair sites involving 7 contractors. These contractors were listed according to the following Dun & Bradstreet MarketPlace industry classifications: concrete construction (roads, highways, sidewalks; SIC codes 1611–0202), general contractor (highway and street construction; SIC codes 1611–9901), and highway- and street-paving contractor (SIC codes 1611–0204). A total of 52 samples were collected for 7 of the 9 typical tasks: operating a jackhammer, sawing concrete, milling concrete, cleaning up concrete, drilling dowels, milling asphalt, and cleaning up asphalt. Samples were not collected for scabbling (small-scale surface milling) and grooving (surface depth cutting). The percentage of crystalline silica contained in the

dust of an air sample was used to calculate the OSHA PEL for each respective sample.

Airborne levels of crystalline silica associated with 7 major road repair tasks are shown in Table 3. Sample results indicated a significant risk of overexposure to crystalline silica for workers who performed the 5 highway repair tasks involving concrete. Mean sample results for these 5 tasks exceeded the ACGIH TLV for crystalline silica. Sample results in excess of the OSHA PEL were found for operating a jackhammer (88% of samples), sawing concrete

and milling concrete tasks (100% of samples); cleaning up concrete tasks (67% of samples); and drilling dowels (100% of samples). No measured exposures in excess of the PEL were found for milling asphalt and cleaning up asphalt; however, of the 8 samples collected for milling asphalt, 6 (55%) results approached the OSHA PEL, and 1 was at 92% of the PEL. The percentage of samples exceeding the more stringent ACGIH TLV was even greater. No dust-control measures were in place during the sampling of these highway repair operations.

**DISCUSSION**

Large-scale public works projects and silicosis share a common history. For example, the Hawk's Nest disaster<sup>28,29</sup> and water tunnel construction in New York City<sup>30,31</sup> led to epidemics of silicosis among the respective worker populations. Although highway maintenance construction does not fit the definition of a large-scale project, the ubiquity of maintenance projects throughout the United States could conceivably result in hazardous silica exposures for many more workers than those caused by large scale projects. In the United States, almost 1 million workers are employed in SIC 16 jobs—heavy construction other than building construction. Approximately 350 000 (39%) of these workers are employed in highway and street construction, with an additional 54 000 (6%) employed in bridge, tunnel, and elevated-highway construction. Recent congressional legislation has authorized substantial spending for

**TABLE 3—Task-Based Silica Exposures: Sample Data**

Task	No. of Samples	Range of Sample Results (mg/m <sup>3</sup> ) <sup>a</sup>	Mean (mg/m <sup>3</sup> ) <sup>a</sup>	SD	No. (%) of Samples Above OSHA PEL	No. (%) of Samples Above ACGIH TLV
Operating a jackhammer	25	0.03–0.63	0.276	0.161	22 (88)	24 (96)
Sawing concrete	6	0.15–0.50	0.348	0.144	6 (100)	6 (100)
Milling concrete	2	0.99–1.15	1.070	0.113	2 (100)	2 (100)
Cleaning up concrete	6	0.02–0.26	0.152	0.099	4 (67)	5 (83)
Milling asphalt	8	nd–0.07	0.041	0.027	0	4 (50)
Cleaning up asphalt	3	nd–0.02	0.007	0.012	0	0
Drilling dowels	2	0.05–0.16	0.107	0.076	2 (100)	2 (100)

Note. mg/m<sup>3</sup> = milligrams of respirable dust per cubic meter of air; OSHA PEL = Occupational Safety and Health Administration permissible exposure limit; ACGIH TLV = American Conference of Industrial Hygienists threshold limit value; nd = nondetectable (below lower detection limit).  
<sup>a</sup>8-hour time-weighted-average samples.

rehabilitation of the national highway system. This emphasis on rebuilding road infrastructure creates a scenario in which large numbers of workers will be exposed to crystalline silica dust and silicosis incidence will increase.

Occupational disease surveillance case data from the New Jersey, Michigan, and Ohio SENSOR programs indicate that workers employed in certain occupations in the construction industry are at risk of developing silicosis. The disease evidence is less clear for highway construction workers, because the majority of identified cases in this group occurred in individuals working in tunnel construction. Only 3 (7%) of the 45 SENSOR-reported silicosis cases in the construction industry between 1993 and 1997 had work history data identifying exposure specific to highway construction work. A sentinel-event surveillance system such as SENSOR is limited in its ability to detect a long-latency chronic disease among the worker population because of the relatively short time that modern highway repair methods have been in use. This lack of sensitivity in identifying silicosis among a newly exposed population demonstrates the importance of using hazard-surveillance methods to identify populations at high risk and to target preventive interventions. Hazard surveillance refers to the ongoing assessment and evaluation of hazardous substance use in the workplace and of worker exposure to these hazardous materials.<sup>32,33</sup> High exposure to crystalline silica from routine activities is sufficient evidence of the need to develop and implement increased public health prevention activities for the identified industry.

Concrete disturbance and removal during highway repair projects generate high levels of airborne crystalline silica dust. However, highway worker exposure to crystalline silica is variable. Highway repair work is conducted in an open-air environment in which weather conditions can affect exposure levels. Intense exposure can potentially occur when larger-scale projects are conducted in an assembly-line fashion and when tasks that generate dust, such as operating a jackhammer or sawing concrete, are performed continuously for a full 8-hour shift. Conversely, crews that work on small road-repair projects spend about half the shift removing the existing concrete and the remaining time doing relatively dust-free patch work,

resulting in lower overall exposures to silica dust. A highway worker who performs a non-exposure task (e.g., a flagman) can potentially be exposed to dust generated by other tasks performed nearby. The amount of highway repair work contracted to a specific contractor is dependent on available projects and successful bidding. Companies involved in this type of work also specialize in types of construction work not involving concrete. Thus, employees may be exposed to silica dust on only an intermittent basis. Also, the highway worker may be a general laborer who is involved in other work than highway repair. Highway repair methods may vary in different parts of the country; for example, the Connecticut Department of Transportation will sometimes require the use of water to control dust during construction work. New Jersey projects do not use water because of potential problems with construction material performance, environmental concerns with slurry runoff, costs associated with vehicle cleanup and paint damage claims from passing motorists, and concerns about hazardous driving conditions on wet roadways.

The air-sampling results in Table 3 show levels of respirable silica dust above the OSHA PEL for 6 of the 8 tasks performed during highway repair. For typical tasks such as operating a jackhammer and sawing concrete, average silica exposures approached 3 times the regulatory limit, whereas sample results for milling concrete were more than 10 times this limit. Exposures were dramatically higher than the limits established by ACGIH for protection against silicosis. The recently adopted ACGIH TLV is at most one half the current OSHA PEL. One must consider that the OSHA PEL for crystalline silica is based on outdated toxicological information from the late 1960s. OSHA has placed crystalline silica on its Semi-annual Regulatory Agenda (in the proposed rule stage<sup>34</sup>) to develop a comprehensive standard for exposure to crystalline silica.

The various exposure limits for crystalline silica have been established to prevent silicosis, but they do not address the risk of cancer associated with crystalline silica exposure. The International Agency for Research on Cancer has designated inhaled crystalline silica as a Class I carcinogen,<sup>35</sup> and the National Toxicological Program has designated it as a substance known to be a human carcino-

gen.<sup>36</sup> The ACGIH lists quartz silica as a "suspected human carcinogen."<sup>37</sup> Prudent occupational health practice dictates that exposures to known and suspected carcinogens be maintained at levels as low as reasonably achievable.

To reduce worker exposure, future activities addressing the silica exposure hazard must focus on prevention. Research on concrete, stone, and masonry jobs that involve drilling and sawing has demonstrated the efficacy of water in reducing dust levels to which workers are exposed.<sup>38-40</sup> A project carried out through the New Jersey Silica Partnership observed a significant reduction of dust generated by jackhammers during concrete breakup when a low-volume water spray or local exhaust ventilation were used.<sup>41</sup> Until feasible engineering controls are developed and effectively deployed, highway workers must rely on appropriate hazard awareness training and respiratory protection to control their exposures to crystalline silica dust. Highway workers should be required to wear half-mask air-purifying respirators fitted with high-efficiency N-100 or P-100 filters as part of a comprehensive respiratory protection program.

Continued research is needed to confirm the link between silicosis and highway repair work. Modern highway repair methods did not begin until the mid-1980s, and jobs that utilize these methods are increasing in number as the nation's highway infrastructure is rebuilt. A cohort of high-risk highway repair workers with long-term exposures could be medically screened for silicosis to further evaluate the disease potential among this occupational group.

The NJDOT has implemented a proposal to include silica safety and health language in highway repair contracts similar to the language for lead exposure in contracts for bridge-painting projects. This strategy has worked especially well in reducing lead levels in the blood of workers who are involved in bridge-painting operations.<sup>42</sup> In the continued absence of comprehensive federal regulations for silica exposure, Federal Highway Administration and state department of transportation contracts for highway repair should require basic preventive actions, such as dust control, exposure monitoring, respirator use, and training to protect highway repair workers from silicosis. ■

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## Contributors

D.J. Valiante conceived the project and wrote the article. D.P. Schill directed the project and helped analyze the data. K.D. Rosenman helped conceive the project, and E. Socie reviewed interim data and provided data analysis. All authors provided substantive contributions to the article.

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## Human Participant Protection

The disease surveillance component of this project was both reviewed and approved by the institutional review board of the New Jersey Department of Health and Senior Services. The environmental evaluation component of the study was exempt from institutional review board approval because no personal identifiers were involved. No informed consent was obtained, because study participants were not enrolled.

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