OF THE CALIFORNIA DENTAL ASSOCIATION

Journal

AUGUST 2009

Barriers to Care

Functional Limitations

Adult Oral Health Status

Adult Oral Health Status: FACTORS & BARRIERS

Timothy T. Brown, PhD, and Jon Roth, CAE

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DEPARTMENTS

FEATURES

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ORAL HEALTH AND THE DEMAND FOR DENTAL CARE

TIMOTHY T. BROWN, PHD

Good oral health is integral to every individual's overall quality of life and untreated oral diseases can greatly compromise this quality. Oral diseases are often distributed unevenly in society, afflicting some subgroups of the population disproportionately. In addition, large disparities exist in access to dental care, which can perpetuate the uneven distribution of oral diseases in society.

AUTHOR

Timothy T. Brown, PHD, is associate director of research at the Petris Center and assistant adjunct professor of health economics, University of California at Berkeley.

In order to make good oral health policy, policy-makers must know the current extent of the problem: The distribution of oral health across an area and the factors that are associated with varying levels of oral health. They must also know the degree to which dental services are currently being provided to deal with the oral health problems that exist, and to what extent oral health needs are not being met. The same knowledge is needed by private entrepreneurs in their quest to provide dental services to new market segments.

In this issue of the *Journal of the California Dental Association*, we present four studies that focus on oral health and the demand for dental care. These studies represent the most currently available California-specific information on these topics. They are intended to inform both dental professionals and policy-makers as to the oral health status of adults in California and the patterns of care seeking among adults in California.

While each study contains information on Denti-Cal, which has eliminated optional adult dental services as of July 1, 2009, this information is still important as Denti-Cal may be restored once the state economy recovers. The information contained in this issue would then be useful in determining the association of Denti-Cal coverage with access to dental care and would be highly relevant in the potential redesign of any future version of Denti-Cal.

Two studies in this issue focus on the oral health of adults and seniors, respectively. Dr. Finlayson and colleagues use a surprisingly robust measure, missing teeth due to disease, to determine the distribution of oral health across sociodemographic characteristics. My colleagues and I use the same measure to determine the

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distribution of oral health across the socioeconomic characteristics of seniors. Each study examines oral health over an 11-year period: 1995-2006.

These studies provide specific information on who in our state suffers the most from poor oral health.

Two additional studies in this issue focus on the demand for dental care among adults and seniors, respectively. These studies add to the above studies by determining the sociodemographic patterns of those who access dental care in California. My colleagues and I examine the economic demand for dental care and the perception of financial barriers in receiving needed dental care among adults. Included in this study are instructions on how readers can use the information provided, using Microsoft Excel, to predict the probability of demanding dental care or perceiving a financial barrier in receiving dental care for any particular sociodemographic group in California.

My colleagues and I also present an examination of the extent to which functional limitations prevent seniors from accessing care. This information allows for an accurate estimate of the number of individuals who would likely access dental care if they were not hindered by functional limitations. Potential interventions for improving this situation are considered.

The current patterns in California regarding oral health, the demand for dental care, perceptions of financial barriers in receiving needed dental care, and functional limitations that limit access to dental care are all critical topics that present opportunities for both policymakers and private entrepreneurs. It is our hope that this information stimulates the efforts of both groups. ■■■■

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Coming to California?

BRIAN SHUE, DDS

Imagine a world where a brand-new category of provider is created to meet the health care needs of the underserved. Naturally, many questions will arise. What about patient safety? How would a new class of providers without a doctorate degree provide proper care and protect the interests of the profession and patient? How and in what form is the patient going to receive responsible and reliable care from this new type of health care provider? How can they operate independently in the clinic environment and with what supervision?

This new health care provider would then enter into a world where he or she may not be widely accepted by the profession. There would be arguments about the training and education, and compensation. There would be questions about the pros and cons of independent practice. There would also be questions about whether there is even a need for this type of provider.

That was the story of the birth of the dental hygienist. Do the concerns surrounding the issue sound familiar? Various stakeholders are now searching for a response to oral health access challenges and have produced four models of new providers: community dental health coordinator, dental therapist, advanced dental therapist, and advance dental hygiene practitioner (also labeled "oral health professional" recently in Minnesota). The first two categories are essentially dental team members who are able to perform significant clinical work only under the supervision of a dentist. The latter two categories are midlevel providers and would provide significant clinical care without supervision.

Various stakeholders are now searching for a response to oral health access challenges and have produced four models of new providers.

Midlevel providers were created in medicine in the 1960s to address health care access deficiencies.[1] They are individuals, like nurse practitioners, who hold a master's degree in addition to their baccalaureate degree and provide care without supervision. Hygiene stakeholders have been advocating for this type of model. However, the dental therapist role that emerged from Minnesota is not a midlevel provider. In other countries, the traditionally defined "dental therapist" receives a two-year training and has a long history of providing care to children, but still operate as members of the dental team though the dentist team leader may provide remote oversight rather than direct supervision.

The concept only recently came to the United States in the form of Alaska's dental health aide therapist. The American Dental Association initially opposed establishment of this provider category then settled its litigation and agreed to work with Alaska to help address the longstanding absence of oral health care in the remotest regions of that state.

Then there's Minnesota. For the first time, dental therapists and dental midlevel providers became legal in the continental United States when Minnesota Gov. Tim Pawlenty signed Senate File 2083 on May 16, 2009.[2]

That may be just the beginning. Currently, there are 12 states that are addressing the dental workforce issue, including California. Additionally, there are 36 states where oral health coalitions have been created, where only five existed just a few years ago, according to Shelly Gehshan, director, Advancing Children's Dental Health Initiative, PEW Center on the States in a presentation to the California Dental Association's Board of Trustees on June 6.

What does a dental therapist, as defined by Minnesota, do? Here are the responsibilities:

- Provide preventive services;
- Prep and place restorations;
- Perform pulpal therapies;
- Extract primary teeth;
- Provide care to children and adults; and
- Work with on-site dentist supervision.

The dental therapist will be educated at the University of Minnesota in a four-year bachelor's of science degree in dental therapy. The dental therapist is essentially a supervised member of the dentist's staff who can perform many irreversible procedures (even the term "irreversible procedure" stirs up negative connotations among some stakeholders and the use of the term may be on its way out).

With more experience, the dental therapist can become an advanced den-

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tal therapist, and can do the following additional duties:

- Extract periodontally involved adult teeth;
- Work without on-site dentist supervision; and
- Create treatment plans that require dentist approval.

The advanced dental therapist must have 2,000 hours of experience as a dental therapist and receive a master's in dental therapy in a 28-month program.[3]

So how did this happen? Organized dentistry had difficulty maintaining a leadership role and early on found itself entrenched in a defensive position against criticisms coming from a large and active public health coalition. The Minnesota Dental Association and the University of Minnesota School of Dentistry created the dental therapist to counter the unsupervised oral health practitioner model, with additional public affairs assistance from the American Dental Association. This collaboration focused on patient safety and dentist supervision; it dramatically altered the outcome.

As can often occur when the legislature gets involved in trying to craft a compromise, the results can leave much to be desired. In this case, the two new models are flawed in the opinion of various stakeholders.

The results? It has been questioned about how much impact the new dental therapist will have, particularly in rural settings, as they were designed to work as part of the traditional dental team and it won't improve access to care if there is no dentist present to begin with. Some have argued that the dental therapist education is too lengthy, as it requires two more years of education compared to the education of therapists from other countries.

Additionally, the new advanced dental therapist provider, which will require six years of education while earning a master's degree, will not be part of a dental team, and will operate in an autonomous fashion just like the nurse practitioner. While this compromise has calmed activity for the time being and "bought" a certain amount of time, it may have created a minimally effective new provider as well as another totally unnecessary provider. Time will tell.

As seen in Minnesota, legislation can move forward to enact change whether or not it is supported by dentistry. The CDA is well-prepared to tackle this issue.

Access to care has been the issue getting the most attention by the ADA of late.[4] The ADA's answer to the workforce dilemma is the community dental health coordinator workforce model, but note it is far different and limited in scope when compared with the enacted legislation in Minnesota. The community dental health coordinator will assist in coordination and navigation of care, as well as providing community education.[5]

Also, the community dental health coordinator can provide preventive services, including sealants, temporary fillings without decay excavation and "selective scaling for plaque-induced gingivitis" under the supervision of a dentist.[6] This newly created dental team member is currently undergoing pilot tests at three underserved sites across the United States.

It remains to be seen if this ADA model will be accepted by various oral health stakeholders across the country as a sufficient solution toward providing access to care. Unfortunately, it wasn't seen as such in Minnesota, where other stakeholders went directly to legislation to enact change.

Is this going to happen in California?

Here is a better question: Is the CDA leadership ready to respond to this issue?

Yes. CDA participates in various activities to evaluate and understand this workforce movement and remains well aware of the challenges that it may face including the various interests and intent of other stakeholders in oral health care. As seen in Minnesota, legislation can move forward to enact change whether or not it is supported by dentistry. The CDA is well-prepared to tackle this issue.

The CDA Board of Trustees has held various informational presentations on this issue since last year by several national workforce experts in the field. The CDA Executive Committee and Board of Trustees are to be commended for their foresight into the matter.

Another example is the CDA Workforce and Forecasting Taskforce that began this March, led by Patrick J. Ferrillo, Jr., DDS, dean of Arthur A. Dugoni School of Dentistry. "The purpose (of the taskforce) is to look at the need for access issue and to identify how California can solve this problem," Ferrillo said in a phone interview.

Another great link is our CDA Foundation chair, Lindsey A. Robinson, DDS, who also holds the position of chair, ADA Council on Access, Prevention and Interprofessional Relations. In March, she hosted the first ADA Access to Dental Care Summit in Chicago; and at the most recent Board of Trustees meeting, she identified and discussed the various stakeholders in access to care issues, which include dental special-interest groups, dental education and research communities, finance partners, advocacy groups, health care policymakers, dental industry/business community, nondental health workers federal agencies, safety net dental providers, ADA leadership, state

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dental association executive directors and volunteer dental leaders. All of these entities may or may not have views congruent with the CDA.

The CDA leadership has also participated in several oral health workforce conferences throughout the country, including an ongoing 12-state Boston Workforce Meeting. "We want to be proactive instead of reactive," said Ferrillo, adding, "While ensuring the citizens will get good oral health."

We need to continue to study these workforce issues and carefully examine all options — while they are still options — and participate in stakeholder meetings. We need to identify our opportunities, but remain wary of unintended consequences. Much can be learned from what happened in Minnesota.

CDA needs to continue to represent its members while remaining true to its commitment for oral health care for California. Our vision states: "The California Dental Association is the recognized leader for excellence in member services and advocacy promoting oral health and the profession of dentistry." Nothing could be closer to the truth. ■■■■

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Matt Mullin

Moral Luck

BY DAVID W. CHAMBERS, PHD

The way things turn out in life is a combination of our skill and effort, plus a little luck. It is beyond our ability to control everything. Our child catches pneumonia just before the long-anticipated outing to Disney World. About 5 percent of root canal therapies fail, despite being performed by well-trained, generally successful practitioners who follow standard protocol.

The same is true in ethics. Patients sue even when they have given fully informed consent. Good Samaritan laws have been written specifically to protect well-intended health professionals. California has a fund to indemnify professionals who refer suspected abuse to Child Protective Services. It is clearly understood that not every act undertaken for morally sound motives will have a positive outcome. It is disappointing

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Heraeus Venus Diamond

Venus Diamond is a new universal nano-hybrid composite. The composite provides unique handling, strength and durability, low shrinkage, holds a long- lasting polish and good color adaptation. Venus Diamond allows for sculptability and blends well with natural tooth structures. Venus Diamond composite gives extended working time under the operating light, it doesn't stick to instruments, and allows sculpting to be easier and more efficient. For more information go to heraeus-venus.com.

Color Me Sad: Certain Face Paints Causing Skin Problems

Adverse reactions from face paint items have prompted the Food and Drug Administration to notify health care professionals and consumers about products labeled as distributed by the Oriental Trading Co., Omaha, Neb.

Rashes, burning sensation, swelling, and itchiness were reported as occurring on the same day and skin site of the application. Following testing by an FDA lab, significant microbial contamination was indicated in most of the products. Fun Express Inc., a wholly owned subsidiary of Oriental Trading Co., is voluntarily recalling face paints manufactured by Shanghai Art Stationery Company Limited, Shanghai, China.

Health care providers and consumers are encouraged to report any incidences of face paint reaction to the FDA, in addition to local and state health authorities. Reports can be made online at https://www.accessdata.fda.gov/scripts/medwatch/medwatch-online.htm; calling (800) 332-1088; mailing to MedWatch, 5600 Fishers Lane, Rockville, MD 20852-9787; or faxing to (800) 332-0178.

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Reaching Out to Patients Using Social Media

One hundred forty characters or less may be a way for dentists to broach the subject of sleep breathing disorders to their patients.

Speaking at the annual meeting of the American Academy of Dental Sleep Medicine, on the subject of educating the public about dentistry's role in the management of snoring and sleep apnea, Laurence Barsh, DMD, advised attendees that the profession has an obligation to screen dental patients for snoring and sleep apnea and work with physicians in management of treatment.

"Social media sites like Facebook and Twitter are ideal ways to start a conversation with the public who may not know that their health can be affected by problems with breathing during sleep," said Barsh in a previous interview. "Our role as doctors is primarily one of education. People who are unaware that they may have a sleep-breathing problem are online, and we have to go where they are if we are to succeed in any form of awareness campaign."

While Barsh commented that practice Web sites are an ideal way to educate the public about the medical condition, more efforts, such as social media sites, are needed to reach those who may be unaware they have a sleep breathing disorder.

An estimated 20 million men, women, and children in the United States alone suffer from obstructive sleep apnea. (Millions more snore.) Of these 20 million, only about 10 percent have been diagnosed, despite that the average life span of an untreated sleep apneic is years less than those without sleep apnea.

Heart attacks, heart disease, stroke, diabetes, high blood pressure, depression, erectile dysfunction, and obesity, in addition to car deaths and injuries have been related to sleep apnea and snoring. Billions of dollars are estimated in relation to the increased medical costs of sleep apnea that is untreated.

Heraeus Flexitime Bite

Flexitime Bite is the first step in the Venus Smile Esthetic System. Flexitime Bite is a new bite registration material with a whipped cream-like consistency that allows for accuracy and comfort. The material hardens in 30 seconds and has an extremely high shore D hardness of 40. Flexitime Bite is not only a standard bite registration material; it is also scannable without the use of powder, which makes it more efficient. For more information go to heraeus-kulzer-us.com.

Weigh Radiation Risks vs. Benefits of Tests

Balance must be taken into consideration when it comes to radiation. While it is helpful that physicians can zap blocked arteries or conduct an examination of the heart without opening the chest cavity, radiation exposure can damage DNA, leading to uncontrolled cell division, according to a recent issue of the *Harvard Heart Letter*.

Certain nuclear stress tests and computed tomography scans can serve up to 10 times the annual background dose in contrast to a tiny amount of the natural background radiation for a chest X-ray. Although the cancer risk from a single medical test or procedure is low in general, for every 1,000 people exposed to the amount of radiation delivered by a cardiac CT scan, the radiation can add one extra case of cancer to the 420 cases that would normally occur. It is estimated that radiation from CT scans now accounts for 1.5 percent of all cancers in the United States.

Because the amount of radiation delivered depends on the medical test, how does one protect oneself? Are all tests worth the radiation received? The *Harvard Heart Letter* noted that one shouldn't agree to medical testing that involves radiation, or ask for it, unless it will give you and your doctor important information about your health. And even then, ask if you can get the lowest radiation dose possible.

To read the article in full, go to https://www.health.harvard.edu/newsletters/Harvard_Heart_Letter/2009/April/Radiation-in-medicine-A-double-edged-sword?utm_source=heart&utm_medium=pressrelease&utm_campaign=heart0409 .

Simple Ways to Prevent Sinusitis

When is a cold not a cold? When it's sinusitis, that pesky condition when the sinuses and nasal passages become infected, leading to bacteria or viruses becoming trapped in an unhealthy glob of mucus.

Left to its own devices, the germs grow out of control and result in swelling, which in turn can cause facial pain and headaches, a build up of mucus that produces congestion, and a thickening and tinting of the mucus when white blood cells are dispatched to fight the infection.

But relief of this common infection can be had with several relatively easy treatments ranging from daily bathing of nasal passages and good hydration to inhaling steam, according to a report in a recent issue in the *Harvard Women's Health Watch*.

Using a small pot or squeeze device daily, irrigate the nasal passages, which help moisten mucus membranes and clears excess mucus. Staying hydrated keeps mucus loose and thin. Lingering in a hot shower may also help. Another option is to pour boiling water into a pan and hovering over it while covering one's head with a towel. Inhaling the steam helps moisten the nasal passages.

Community Dental Health Coordinator Program Rolled Out

The American Dental Association has launched a pilot program in an effort to deliver dental care to underserved people in rural, urban, and Native American communities in several states. This program creates a new dental health team member: community dental health coordinator.

These coordinators are supported by a dental team working under the supervision of a dentist, drawn from the communities they are intended to serve. As a community member, they can serve as role models by empowering their neighbors to take an active role in their oral health care such as twice-a-day brushing with fluoride toothpaste, eating a balanced diet, and flossing.

What's more, they are able to link patients to existing community-based, public health assistance programs and Medicaid. CDHCs are also trained to provide a range of preventive care services, such as fluoride treatments and placement of sealants. And most importantly, the CDHC is trained to identify serious dental conditions that require immediate attention and will get patients to a dentist.

"This outreach effort is one of several ways that the ADA is addressing access to oral health issues," said ADA President Dr. John S. Findley.

CDHC training consists of a 12-month period of academic course work, followed by a six-month field internship. Students in several states began the academic portion of their training, which is provided via the Internet. Among the several academic institutions providing training is the University of California, Los Angeles.

The CDHC program will train a total of 18 CDHCs in the 2009-2010 academic year. The same number of CDHCs will be graduated over the two remaining program years, to produce a total 54 CDHCs. During the course of this effort, the ADA and its partners will evaluate the program to determine its success.

Dr. Fresh's Spiderman Light Up Toothbrush

Fight cavity crime with the new Spiderman Light Up toothbrush. Spiderman doesn't hold back any of his superpowers when it comes to fighting germs that can cling to children's teeth. He lights up for 60 seconds — the dentist-recommended time to brush each bridge — so that the little Spideys of the world know how long to fight cavities and keep brushing. The toothbrush features Spiderman crouched on top of a high-rise building, looking out for all young children, ages 3 and up. The Spiderman Light Up toothbrush retails for $2.99 and is the newest innovation from Dr. Fresh. For more information go to drfresh.com.

SeLECT Defense by Class One Orthodontics

SeLECT Defense is used to coat brackets, ligature ties, and closing chains to reduce plaque and improve oral hygiene in orthodontic treatment.

The product can also mix with adhesives, cements, and sealants to prevent tooth decalcification or demineralization. SeLECT Defense technology is not removed by tooth brushing. For more information go to selectdefense.com.

Honors

The University of Southern California recently announced the appointment of **Avishai Sadan, DMD,** as dean of its School of Dentistry.

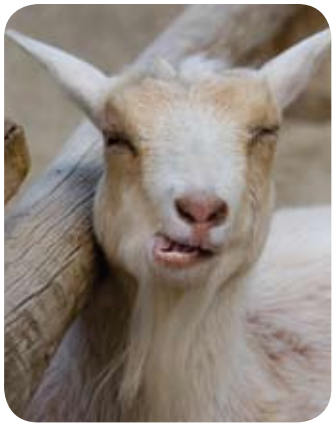
Sadan, who will hold the G. Donald and Marian James Montgomery Dean's Chair in Dentistry, served as associate dean of clinical affairs and professor and chairman of the department of comprehensive care at Case Western Reserve University School of Dental Medicine.

"We are delighted to have professor Avishai Sadan join USC," said USC Executive Vice President and Provost C. L. Max Nikias. "He has distinguished himself at Case Western as a successful administrator and inspiring leader, and we look forward to his service at the USC School of Dentistry as the school continues its mission of educating the finest clinicians, advancing research and enhancing public health."

Sadan, who earned his bachelor's and dental degrees from Hebrew University's Hadassah School of Dental Medicine in Jerusalem, merged the former departments of restorative dentistry and general dentistry at Case Western, restructured all preclinical courses to align with contemporary restorative approaches, reorganized all clinical procedures, and streamlined all preclinical and clinical operations.

Avishai Sadan, DMD

"With the great privilege of joining one of the world's finest schools comes the huge responsibility of maintaining its high level of excellence," Sadan said. "In a highly competitive environment, the school will continue to reinvent itself using its biggest assets: its outstanding students, world-renowned faculty and the most committed and proud core of alumni any school has. We will continue to attract the best candidates, graduate the finest clinicians, generate exciting scientific discoveries and be a resource for the betterment of our community through our strong community outreach."



New Study Shows Promise With Dental Implants

A newly developed procedure using stem cells may provide a more comprehensive regeneration of periodontal tissue around dental implants, according to a new report published in the *Journal of Oral Implantology*.

In this recent study, the authors engineered periodontal tissue in a fresh socket of a goat animal model. According to press release, each of the five goats was fitted with two titanium implants immediately following tooth removal. The control received only the scaffolding while a poly DL-Lactide-co-Glycolide scaffold was fitted around each implant. The experimental implant that received scaffolding was seeded with bone marrow–derived mesenchymal stem cells (BMDSCs). All implant sites showed some level of tissue development at 10 days after the operation. The control side, one month later, showed no signs of tissue development, while the experimental side had developed cementum, bone, and periodontal ligament, the three tissues required for regeneration of periodontal tissue.

An implant's ability to react to the pressure from chewing, future orthodontic work, and patient growth can be reduced if it is not surrounded by sufficient periodontal tissue. Positive results with BMDSCs in perio defects around natural teeth have been demonstrated in previous studies and other research has seen promising results without BMDSCs, using progenitor cells from the remaining ligament in certain limited situations. However, this recent study demonstrated that using BMDSCs can ensure a more thorough, adaptable regeneration of periodontal tissue with titanium implants.

To read the entire article, "Experimental Formation of Periodontal Structure Around Titanium Implants Utilizing Bone Marrow Mesenchymal Stem Cells: A Pilot Study," to go: allenpress.com/pdf/ORIM-35-3-106.pdf.

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when the prospect of things going wrong while trying to help others places a damper on benevolence. It is sadder still when this happens so often that those who had no intention of lending a hand have a ready excuse.

In academic philosophy, Thomas Negal's term "moral luck" refers to the darker side of this phenomenon. Often, bad behavior, intended or otherwise, results in no bad consequences. No harm, no foul. The C.E. course at Banff is written off 100 percent on the tax return, unknowingly by the dentist and undetected by the Internal Revenue Service. For years, the office has been out of compliance with the county health code, but no one has gotten sick as a result. Many times when we step over the line, we are lucky and the world goes on, ignorant of our deceit or foolishness. That does not make us ethical, just lucky.

Something like the doctrine of moral luck is recognized in the law. Driving while intoxicated, in an amazing proportion of cases, has no effect on the world and is soon forgotten. Exactly the same behavior does carry consequences if arrested for driving under the influence. Again, exactly the same behavior is a major tragedy if the driver hits a pedestrian, and manslaughter charges are a distinct possibility. The drinking driver surrenders control over his or her life to luck.

There is a branch of ethics that says it is the intention that makes an act moral or immoral. If that were true, the penalty for attempted murder would be the same as the penalty for murder. There is another branch of philosophy that says only the consequences make act moral or immoral. If that were true, letting periodontal disease go untreated would be the same as causing it. The truth of the matter is that intentions, consequences, the standards of society and one's profession, and luck all combine to make morality.

The nub:

1. As a habit, practice far enough above the standard of care that bad luck cannot damage you.
2. Perform an inventory, or get a colleague to help you perform an inventory, of potential negligent practices in your office.
3. Never place more of your reputation on the outcomes of chance than you can afford to lose.

David W. Chambers, PhD, is professor of Dental Education, Arthur A. Dugoni School of Dentistry, San Francisco, and editor of the Journal of the American College of Dentists.

UPCOMING MEETINGS

2009	
Sept. 10-13	*CDA Presents The Art and Science of Dentistry*, San Francisco, 800-CDA-SMILE (232-7645), cda.org.
Sept. 30-Oct.-4	American Dental Association 150th Annual Session, Honolulu, Hawaii, ada.org.
Nov. 2-4	National Network for Oral Health Access National Primary Oral Health Conference, Nashville, Tenn., Luana Harris-Scott (619) 279-5879 or nnoha.org.
Nov. 8-14	United States Dental Tennis Association fall meeting, Scottsdale, Ariz., dentaltennis.org.
2010	
April 11-17	United States Dental Tennis Association, Amelia Island Plantation, Fla., dentaltennis.org.
April 26-28	National Oral Health Conference, St. Louis, Mo., nationaloralhealthconference.com.
May 13-16	*CDA Presents the Art and Science of Dentistry*, Anaheim, 800-CDA-SMILE (232-7645), cda.org.
Sept. 23-26	*CDA Presents the Art and Science of Dentistry*, San Francisco, 800-CDA-SMILE (232-7645), cda.org.
Nov. 7-13	United States Dental Tennis Association, Grand Wailea, Hawaii, dentaltennis.org.

To have an event included on this list of nonprofit association continuing education meetings, please send the information to Upcoming Meetings, CDA Journal, 1201 K St., 16th Floor, Sacramento, CA 95814 or fax the information to 916-554-5962.

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More Support Urged for Indian Health Services Dental Care

Currently lacking in staff and facing a considerable exodus by seasoned dentists ready to retire, Indian Health Services is in even more need of funding, said John S. Findley, DDS, president of the American Dental Association.

Telling the U.S. House Committee on interior appropriations this need comes at a time when "childhood caries and periodontal disease among diabetics are rampant," Findley reported that an estimated 65 percent of the agency's dental specialists are eligible for retirement this year.

Findley requested the subcommittee boost the program by $1 million in order to train new specialists and ensure there is funding for future budgets. Among Hispanic children in the 2- to 5-year-old age group, the rate of decay is 41 percent; 19 percent for white children; and 29 percent for black children.

However, "approximately 79 percent of Indian children 2 to 5-years-old have dental decay — a level that far exceeds other ethnic groups," said Findley. "The ADA would like to see this eradicated, and within five years, see that every Native American child is caries free."

The agency needs dentists who have completed residencies in oral surgery, pediatric dentistry, as well as other dental specialties in order to provide needed advanced oral health care, Findley said.

FDI Supports Warnings on Tobacco Products

The FDI is supporting the World Health Organization's call to action for "all governments to implement, without delay, the legislative framework necessary to require large pictorial warning on all tobacco packaging."

Additionally, the FDI has repeatedly emphasized the important role of oral health professionals and their associations in tobacco control, patient counseling and advocacy, according to a press release. The joint FDI/WHO publication *Tobacco or Oral Health*, which is available in five languages, outlines how dentists and their teams can effectively engage in tobacco control.

"Helping tobacco users to reduce or quit can be the single most important health advice a dentist can give to a patient," said Burton Conrod, DDS, FDI president.

Health warnings on tobacco products are crucial elements in the global fight for tobacco control, according to a press release. The FDI World Dental Federation, which spoke on behalf of more than 1 million dentists during the World No Tobacco Day held May 31, strongly supports explicit health warnings and encourages their widespread implementation.

All too often, consumers are not fully aware of the health risks of tobacco use. Knowledge and awareness are the first steps in changing behavior and reducing tobacco use. All tobacco products have a serious impact on oral health. Tobacco use remains the most important risk factor for oral cancer and other oral diseases, and is a leading cause of tooth loss in adults, the press release stated. Using tobacco-related oral diseases in pictorial health warnings on tobacco packaging is a very effective way of communicating about the risks of tobacco use. The oral effects of tobacco use are easily visible and understandable for everyone and may help in motivating consumers to reduce or quit.

To read the press release in full, go to: fdiworldental.org/federation/7_1_WNTD_en.html.

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In order to make good oral health policy, policy-makers must know the current extent of the problem: The distribution of oral health across an area and the factors that are associated with varying levels of oral health. They must also know the degree to which dental services are currently being provided to deal with the oral health problems that exist, and to what extent oral health needs are not being met. The same knowledge is needed by private entrepreneurs in their quest to provide dental services to new market segments.

In this issue of the *Journal of the California Dental Association*, we present four studies that focus on oral health and the demand for dental care. These studies represent the most currently available California-specific information on these topics. They are intended to inform both dental professionals and policy-makers as to the oral health status of adults in California and the patterns of care seeking among adults in California.

While each study contains information on Denti-Cal, which has eliminated optional adult dental services as of July 1, 2009, this information is still important as Denti-Cal may be restored once the state economy recovers. The information contained in this issue would then be useful in determining the association of Denti-Cal coverage with access to dental care and would be highly relevant in the potential redesign of any future version of Denti-Cal.

Two studies in this issue focus on the oral health of adults and seniors, respectively. Dr. Finlayson and colleagues use a surprisingly robust measure, missing teeth due to disease, to determine the distribution of oral health across sociodemographic characteristics. My colleagues and I use the same measure to determine the

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distribution of oral health across the socioeconomic characteristics of seniors. Each study examines oral health over an 11-year period: 1995-2006.

These studies provide specific information on who in our state suffers the most from poor oral health.

Two additional studies in this issue focus on the demand for dental care among adults and seniors, respectively. These studies add to the above studies by determining the sociodemographic patterns of those who access dental care in California. My colleagues and I examine the economic demand for dental care and the perception of financial barriers in receiving needed dental care among adults. Included in this study are instructions on how readers can use the information provided, using Microsoft Excel, to predict the probability of demanding dental care or perceiving a financial barrier in receiving dental care for any particular sociodemographic group in California.

My colleagues and I also present an examination of the extent to which functional limitations prevent seniors from accessing care. This information allows for an accurate estimate of the number of individuals who would likely access dental care if they were not hindered by functional limitations. Potential interventions for improving this situation are considered.

The current patterns in California regarding oral health, the demand for dental care, perceptions of financial barriers in receiving needed dental care, and functional limitations that limit access to dental care are all critical topics that present opportunities for both policymakers and private entrepreneurs. It is our hope that this information stimulates the efforts of both groups. ■■■■

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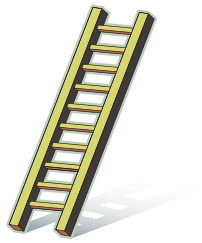

The Demand for Dental Care and Financial Barriers in Accessing Care Among Adults in California

TIMOTHY T. BROWN, PHD; TRACY L. FINLAYSON, PHD; BRENT D. FULTON, PHD; AND SALAR JAHEDI, PHD

ABSTRACT Receiving dental care is positively related to having dental insurance; being female; increasing age; being white, Hispanic or Asian; higher levels of education; higher levels of family income; better health status; and being unmarried. In contrast, being more likely to perceive financial barriers to receiving needed dental care is positively related to lacking dental insurance, being female, being younger, being black or other race, having less education, lower family income, and having worse health status.

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Dental care is important in the maintenance of good oral health.[1] Regular dental visits allow adults to gain expert opinions about the state of their oral health, receive preventive care, learn the latest preventive practices, as well as receive needed restorative care. Access to dental care, adapting the definition of access to general health services from the Institute of Medicine, can be defined as "the timely use of personal (dental) health services to achieve the best possible (oral) health outcomes."[2]

Since many oral health problems are not easily visible and often produce no discomfort in their early stages, determining whether individuals are accessing sufficient dental services to achieve the best possible oral health outcomes requires an accurate and complete assessment by a dentist.

As a result, determining precisely how access to dental care varies across socioeconomic groups in California is prohibitively expensive. Given the high cost of clinical examination and the need for policymakers to understand how access to dental care varies across socioeconomic groups in California, self-reported measures emerge as a reasonable way to gather essential policy-relevant information at a reasonable cost. Past work using such self-reported measures to deter-

mine access to dental care in California has been done, but updated and more comprehensive information is needed.[3]

Two valuable self-reported measures are (1) the utilization of dental care and (2) the existence of financial barriers that prevent individuals from being able to afford needed dental care (based on their perceived need for dental care). The validity of self-reported dental visits has been found to be good.[4] However, when comparing actual clinical examination to self-reported measures of need, it has been found that self-reported measures underestimate clinical need.[5]

In addition, when comparing clinically determined measures of need with self-reported measures of disease and pain, it has been found that people are more likely to act on self-reported measures rather than clinically determined measures.[6] This suggests that self-reported measures of need are useful but should be considered a lower bound in measuring need.

In the following analysis, utilization of dental care serves as a proxy for access to care and financial barriers that prevent an individual from being able to afford needed dental care serve as a proxy for lack of access to care. These are two complementary ways of looking at the same phenomenon. Note that it is possible for the same person to be in seemingly contradictory categories: a person may have received dental care in the last 12 months but not have received as much dental care as they believed was needed (due to financial barriers).

The authors use the concept of economic demand to organize their analysis. The economic theory of demand states that as prices rise, individuals purchase less dental care, and as family income rises, individuals purchase more dental care, other things equal. If stated in terms of not being able to afford needed care, the economic theory of demand states that as prices rise, individuals are more likely to not be able to afford needed dental care, and as family income rises, individuals are less likely to not be able to afford needed dental care. In other words, the economic model of demand when applied to visits is inverse to the economic model of demand when applied to affordability. Estimating both models acts as a check on the reliability of the results.

Methods

Data

This analysis used data from the California Health Interview Survey, CHIS, for the years 2001 and 2003.[7] The CHIS is a state health survey which focuses on public health and access to health care. It is the largest state-level survey conducted in the U.S. and is designed to produce reliable state-level and county-level estimates. Data were collected from adults aged 18 and older through a random digit dial telephone survey. The 2001 and 2003 CHIS sample sizes are 56,279 and 42,044, respectively.

Statistical Analysis

The authors' statistical models examined the extent to which (1) the use of dental services and (2) whether needed dental care is considered unaffordable are associated with the financial and nonfinancial characteristics of individuals. Financial characteristics include the price of dental services, whether an individual has dental insurance, and family income. Nonfinancial characteristics include those that might influence an individual's preferences or inclination to seek dental services such as their general health status, racial/ethnic group, whether they were born in the United States, age, gender, marital status, and level of education. The prices of products and services related to dental services, the relative cost of living, general weather patterns, local culture, and other county-level characteristics may also affect an individual's inclination to seek dental services.

The dependent variable in each model is defined as follows: (1) use of dental care in the last 12 months is indicated by a one and no use of dental care in the last 12 months is indicated by a zero; (2) not receiving needed dental care in the last 12 months because of a lack of affordability is indicated by a one and no such problems in receiving dental care are indicated by a zero. All models include measures of dental insurance (no dental insurance, private dental insurance, Denti-Cal), and individual family income as a percent of the federal poverty threshold (0-99 percent,100-199 percent, 200-299 percent, 300+ percent).

The authors also included information on gender (male, female), age (18-24, 25-34; 35-44; 45-54; 55-64, 65-74, and 75 or greater), race/ethnicity (white, Asian/Pacific Islander, Hispanic, black, and other race), marital status (unmarried, married), birthplace (U.S.-born, foreign-born), self-reported general health status (excellent, very good, good, fair, poor), and education (less than high school, high school graduate, post-high school training, college graduate, post-college). In addition, the authors included N-1 county-level dummy variables where N is the number of counties (58) designated in the data, and an additional variable that contains the value of the year.

Note that the model of the use of dental services includes data from both 2001 and 2003, while the model of the affordability of needed dental care only used data from 2003 (no affordability data

were available for 2001). In the model that included data from both 2001 and 2003, the county-level dummy variables picked up the effects of all nontime-varying omitted characteristics at the county level, such as the prices of products and services related to dental services, the availability of dental services, the relative cost of living, general weather patterns, local culture, and other county-level characteristics, all of which will tend to be fairly constant within counties over a three-year period of time, but vary between counties.

All regressions are estimated using probit models with Stata 9.2. The marginal probabilities reported represent predicted changes in probability, on a scale from 0 to 1 (e.g., a coefficient of 0.05 implies a five-percentage points increase in the probability of a person receiving dental care). Each marginal probability is computed at the mean of the other independent variables. The statistical analysis accounts for the complex survey design of the CHIS including probability weighting, stratification, and clustering. Due to missing data, the sample size used for the model of dental service use was reduced from 98,323 to 98,100, and the sample size used for the affordability model was reduced from to 42,044 to 42,043.

Results

The Demand for Dental Care in California

TABLE 1 presents descriptive statistics of the data. **TABLE 2** presents the probit parameter estimates as marginal probabilities for the dental visits and affordability models. For example, in the dental visits model, a marginal probability is the difference in the probability that a person with a given characteristic has visited the dentist relative to the reference group when the other variable values are set to their means.

TABLE 1

Descriptive Statistics: Pooled 2001 and 2003 California Health Interview Surveys

Variables	Proportions
DENTAL VISIT IN THE PAST 12 MONTHS	
Yes	0.619
No	0.381
UNABLE TO AFFORD NEEDED CARE IN THE PAST 12 MONTHS*	
Yes	0.204
No	0.796
DENTAL INSURANCE	
Private	0.529
Denti-Cal	0.130
None	0.341
FAMILY INCOME (% OF THE FEDERAL POVERTY THRESHOLD [FPT])	
0-99% of FPT	0.154
100% to 199% of FPT	0.196
200% to 299% of FPT	0.141
300% or higher of FPT	0.509
GENDER	
Male	0.490
Female	0.510
AGE	
18 – 24	0.136
25 – 34	0.202
35 – 44	0.218
45 – 54	0.182
55 – 64	0.115
65 – 74	0.076
75 and older	0.070
RACE/ETHNICITY	
White	0.495
Black	0.060
Asian/Pacific Islander	0.120
Hispanic	0.301
Other	0.024
EDUCATION	
Less than high school	0.209
High school	0.235
Some post-high school	0.255
College graduate	0.184
Post-college	0.117
MARITAL STATUS	
Married	0.548
Unmarried	0.452
BIRTHPLACE	
U.S.-born	0.666
Foreign-born	0.334
GENERAL HEALTH STATUS	
Poor	0.044
Fair	0.156
Good	0.294
Very good	0.304
Excellent	0.202
Observations	98,100

All proportions are calculated using sampling weights to account for the complex survey design of the 2001 and 2003 California Health Interview surveys.

As shown in **TABLE 1**, 61.9 percent of individuals visited a dental professional during the previous year. An individual's financial characteristics are strongly associated with the demand for dental services. As shown in **TABLE 2**, those who have private dental insurance are 15.5 percentage points ($p<0.001$) more likely and those with Denti-Cal are 11.4 percentage points ($p<0.001$) more likely to have visited a dental professional in the last year than those without dental insurance. Those with higher incomes are also more likely to have visited a dental professional in the last year. Those whose family income is 200-299 percent of the federal poverty threshold are 4.3 percentage points ($p<0.001$) more likely and those whose family income is 300 percent or higher

TABLE 2

Demand for Dental Care and Being Unable to Afford Needed Dental Care

Variables	Demand for Care Marginal Probability	95% Confidence Interval	Unable to Afford Marginal Probability	95% Confidence Interval
DENTAL INSURANCE				
No insurance	reference		reference	
Private	0.155***	[0.145, 0.166]	-0.145***	[-0.158, -0.132]
Denti-Cal	0.114***	[0.098, 0.130]	-0.089***	[-0.101, -0.076]
Family Income				
0-99% of FPT	reference		reference	
100% to 199% of FPT	0.010	[-0.007, 0.027]	0.002	[-0.016, 0.020]
200% to 299% of FPT	0.043***	[0.025, 0.062]	-0.033***	[-0.051, -0.015]
300% or higher of FPT	0.124***	[0.106, 0.141]	-0.138***	[-0.158, -0.118]
GENDER				
Male	reference		reference	
Female	0.058***	[0.049, 0.068]	0.042***	[0.031, 0.053]
Age				
18 – 24	reference		reference	
25 – 34	-0.092***	[-0.112, -0.072]	0.083***	[0.058, 0.108]
35 – 44	-0.051***	[-0.071, -0.032]	0.063***	[0.040, 0.087]
45 – 54	-0.015	[-0.034, 0.004]	0.061***	[0.037, 0.085]
55 – 64	0.022*	[0.002, 0.042]	0.008	[-0.016, 0.031]
65 – 74	0.023*	[0.002, 0.044]	-0.06***	[-0.080, -0.039]
75 or older	0.030**	[0.008, 0.051]	-0.128***	[-0.142, -0.114]
RACE/ETHNICITY				
White	reference		reference	
Black	-0.042***	[-0.063, -0.021]	0.031**	[0.007, 0.056]
Asian/Pacific Islander	-0.013	[-0.032, 0.005]	-0.033**	[-0.053, -0.014]
Hispanic	0.007	[-0.008, 0.021]	0.009	[-0.008, 0.026]
Other race	-0.071***	[-0.097, -0.045]	0.035*	[0.003, 0.067]
Education				
Less than high school	reference		reference	
High school	0.047***	[0.031, 0.063]	-0.004	[-0.022, 0.013]
Some post-high school	0.073***	[0.057, 0.089]	0.013	[-0.006, 0.032]
College graduate	0.115***	[0.098, 0.132]	-0.023*	[-0.042, -0.003]
Post-college	0.152***	[0.135, 0.169]	-0.049***	[-0.070, -0.029]
GENERAL HEALTH STATUS				
Good	reference		reference	
Excellent	0.071***	[0.058, 0.084]	-0.062***	[-0.076, -0.048]
Very good	0.040***	[0.029, 0.052]	-0.033***	[-0.046, -0.019]
Fair	-0.025**	[-0.040, -0.009]	0.046***	[0.028, 0.065]
Poor	-0.077***	[-0.101, -0.053]	0.093***	[0.063, 0.122]

TABLE 2 CONTINUES ON 543

TABLE 2 CONTINUED FROM 542

MARITAL STATUS				
Unmarried	reference		reference	
Married	-0.047***	[-0.057, -0.037]	0.036	[0.024, 0.048]
BIRTHPLACE				
U.S.-born	reference		reference	
Foreign-born	-0.001	[-0.015, 0.012]	0.030	[0.014, 0.046]
YEAR				
2001	reference			
2003	0.058***	[0.054, 0.063]		
χ^2	5050.17***		2840.80***	
Observations	98,100		42,043	

County dummy variable results not shown. Regression model included sampling weights; the standard errors were estimated using replicate weights that accounted for the complex survey design * p<0.05, **p<0.01, *** p<0.001 (two-tailed z-tests). FPT: federal poverty threshold.

than the federal poverty threshold are 12.4 percentage points (p<0.001) more likely to have visited a dental professional in the last year than those whose family income is less than 100 percent of the federal poverty threshold.

An individual's nonfinancial characteristics are also strongly associated with the demand for dental services. Women are 5.8 percentage points (p<0.001) more likely to have visited a dental professional than men. The association of age and dental visits drops and then rises. Those who are unmarried are 4.7 percentage points (p<0.001) less likely to have visited a dental profession than those who are married. Asians/Pacific Islanders and Hispanics are statistically no more or less likely to have visited a dental professional than whites. However, blacks are 4.2 percentage points (p<0.001) less likely and those from "other" races/ethnicities are 7.1 percentage points (p<0.001) less likely to have visited a dental professional than whites.

More educated persons are more likely to have visited a dental professional. Those with a high school (or equivalent) education are 4.7 percentage points (p<0.001) more likely than those with less than a high school education to have visited a dental professional in the last year. Those with some college are 7.3 percentage points (p<0.001) more likely, those with a college degree are 11.5 percentage points (p<0.001) more likely, and those who have attended graduate school and/or have a graduate degree are 15.2 percentage points (p<0.001) more likely to have visited a dental professional than those who have not completed high school.

Whether an adult was born in the United States or outside its borders was not found to be statistically associated with the demand for dental services in the analyses. Note that this does not distinguish between citizens and noncitizens and that these subgroups may differ in their demand for dental services.

Finally, an adult's general health status is associated with dental visits. Those with excellent health are 7.1 percentage points (p<0.001) more likely and those with very good health are 4.0 percentage points (p<0.001) more likely to have visited a dental professional than those with merely good health. Those with fair health are 2.5 percentage points (p<0.01) less likely and those with poor health are 7.7 percentage points (p<0.001) less likely to have visited a dental professional than those with good health.

Who Needs Dental Care But Cannot Afford It?

A startling one-fifth (20.4 percent) of individuals report being unable to afford needed dental care, as shown in **TABLE 1**. **TABLE 2** presents the marginal probabilities of being in this group for individuals with various characteristics. These findings are based only on the 2003 CHIS. The reference group is made up of the average person in the sample for all characteristics other than the particular characteristic under consideration. In terms of financial characteristics, those who have private dental insurance are 14.5 percentage points (p<0.001) less likely and those with Denti-Cal are 8.9 percentage points (p<0.001) less likely than those without dental insurance to believe they needed dental care but were unable to afford it. Those whose family income is 200-299 percent of the federal poverty threshold are only 3.3 percentage points (p<0.001) less likely to perceive this relative to those whose family income is less than 100 percent of the federal poverty threshold. Those whose family income is 300 percent or above the federal poverty threshold are 13.8 percentage points (p<0.001) less likely to perceive this relative to those whose family income is less than 100 percent of the federal poverty threshold.

TABLE 3

Predicted Probabilities: Dental Visit in the Last 12 Months and Being Unable to Afford Needed Care in Last 12 Months: Selected Subgroups

		Dental Visit	Unable to Afford Needed Care
Subgroup (1):	Private dental insurance, year 2003, male, aged 45-54, white, post-college education, family income 300% or greater than the federal poverty threshold, excellent health, married, U.S.-born, living in Alameda County	0.970	0.018
Subgroup (2):	Denti-Cal insurance, year 2003, female, aged 25-34, black, high school education, family income 200-299% of the federal poverty threshold, very good health, unmarried, U.S.-born, living in Alameda County	0.815	0.186
Subgroup (3):	No dental insurance, year 2003, male, aged 35-44, Hispanic, less than high school education,family income less than 100% of federal poverty threshold, good health, married, foreign-born, living in Alameda County	0.665	0.371
Subgroup (4):	No dental insurance, year 2003, female, aged 65-74, Asian/Pacific Islander, some college education, family income 300% or greater than the federal poverty threshold, good health, unmarried, foreign-born, living in Alameda County	0.870	0.139

An individual's nonfinancial characteristics are also strongly associated with the individual believing that he or she needed dental care, but not being able to afford such care. Women are 4.2 percentage points ($p<0.001$) more likely than men to perceive a financial barrier to needed dental services. The association of age and perceived financial barriers to needed care rises and then drops. Those who are unmarried are not more likely to perceive a financial barrier to needed care than those who are married. Relative to whites, blacks are 3.1 percentage points ($p<0.01$) more likely, and "other" races/ethnicities are 3.5 percentage points ($p<0.05$) more likely to perceive a financial barrier to needed care, while Asians/Pacific Islanders are 3.3 percentage points ($p<0.01$) less likely to perceive a financial barrier to needed care. Hispanics are not different from whites with respect to perceiving financial barriers.

Those with a college degree are 2.3 percentage points ($p<0.05$) less likely to perceive a barrier to needed care than those with less than a high school education, while those who have attended graduate school and/or have a graduate degree are 4.9 percentage points ($p<0.001$) less likely to perceive this than those with less than a high school education. There is no statistical difference between the perceptions of those with other levels of education and those with less than a high school education. Those born outside of the United States are statistically no more or less likely to perceive a financial barrier to needed dental care than the native born.

Finally, one's general health status is also associated with the perception of financial barriers to needed dental care. Those with excellent health are 6.2 percentage points ($p<0.001$) less likely and those with very good health are 3.3 percentage points ($p<0.001$) less likely to have this perception than those whose health is merely good. Those with fair health are 4.6 percentage points ($p<0.001$) more likely and those with poor health are 9.3 percentage points ($p<0.001$) more likely to have this perception than those with good health.

Predicting the Demand for Dental Services in California: Demographic Subgroups

One can get a better picture of the variation in the demand for dental services among different demographic subgroups and the variation in the perception that there are financial barriers in receiving needed dental services among different subgroups by using the above models to predict outcomes for different subgroups. The authors present results for four subgroups in TABLE 3. For readers who would like to compute probabilities for subgroups other than those presented in the text, simple instructions on how to do this in Excel using the untransformed probit coefficients are included in the appendix. Note that while this method allows readers to compute accurate probabilities, it does not allow readers to compute confidence intervals (doing so would require statistical software and the actual data, which includes restricted data accessible only at the Data Access Center at the University of California, Los Angeles, Center for Health Policy Research). Thus, the authors have not included confidence intervals in the numbers reported here.

The authors' four subgroups are as follows: (1) private dental insurance, year 2003, male, aged 45-54, white, post-college education, family income 300 percent or greater than the federal poverty threshold, self-reported excellent health, married, U.S. native, living in Alameda County; (2) Denti-Cal insurance, year 2003, female,

aged 25-34, black, high school education, family income 200-299 percent of the federal poverty threshold, very good health, unmarried, U.S. native, living in Alameda County; (3) no dental insurance, year 2003, male, aged 35-44, Hispanic, less than high school education, family income less than 100 percent of federal poverty threshold, good health, married, foreign-born, living in Alameda County; (4) no dental insurance, year 2003, female, aged 65-74, Asian/Pacific Islander, some college education, family income 300 percent or greater than the federal poverty threshold, good health, unmarried, foreign-born, living in Alameda County.

The authors found that these groups varied a great deal in the probability that they have visited a dental professional in the last year with subgroup (1) having highest probability (0.970) and subgroup (3) having the lowest probability (0.665). It was also found that these groups varied a great deal in the probability that they perceived a financial barrier to receiving needed dental care with subgroup (1) having the lowest probability (0.018) and subgroup (3) having the highest probability (0.371).

Limitations

It should be noted that the dental insurance variables in the authors' models may be endogenous or measured with error. The authors did not correct for endogeneity or measurement error as the authors' models are only intended to be descriptive models, not causal models. For example, a person who decides to visit the dentist may purchase insurance just prior to the visit; hence, the dental visit caused the purchase of the insurance, not vice versa. A number of studies have attempted to correct potential endogeneity using the instrumental variables technique but find that the corrected parameter estimates are larger than the uncorrected parameter esitmates.[8,9] The magnitude of the corrected parameter estimates in the aforementioned studies is far larger than the results for the demand for dental services found in the RAND Health Insurance Experiment.[10] It is thus suggested that the authors' findings are conservative with regard to the association of insurance and dental care visits, that is, they are less than or equal to the true associations.

Additionally, the Denti-Cal insurance variable is not separated by whether individuals with Medi-Cal also know that they have Denti-Cal or not (the data used in this study show that approximately one-third of Medi-Cal enrollees do not know that they also have Denti-Cal insurance). In other words, it is assumed that the percentage of Medi-Cal enrollees who do not know they also have Denti-Cal will not change.

THE DEMAND FOR dental care is strongly related to the financial factors of family income and dental insurance as well as several nonfinancial factors.

Discussion

In this study, the authors found that the demand for dental care is strongly related to the financial factors of family income and dental insurance as well as several nonfinancial factors. Specifically, the demand for dental care is positively related to having dental insurance, being female, increasing age, being white, Hispanic or Asian, having higher levels of education, higher levels of family income, better health status, and being unmarried. In contrast, not being able to afford needed dental care is positively related to lacking dental insurance, being female, younger in age, being black or other race, less educated, lower family income, and having worse health status.

Note that female has a positive association with both the demand for dental care and not being able to afford needed dental care. This simply suggests that, on average, females consistently demand more care then they are receiving.

Since lack of affordability is a major barrier to dental care, one way to solve this problem would be to expand dental insurance coverage (both public and private). However, this would only expand access to the extent that there is excess capacity in the dental care system. Additional studies on the capacity of the dental workforce in California are needed before rational policy planning can take place to expand access to care through the expansion of dental coverage.

However, the above results can aid policymakers in targeting interventions to increase the access of those demographic subgroups that currently have low access to care. In those cases where the subgroup of interest is relatively small, such interventions need not wait until a complete understanding of the capacity of the dental system is completed. Such interventions can greatly enhance the oral health of those targeted and can be expanded as more information about the capacity of the dental care system becomes available. ■■■■

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Appendix: Calculating Probabilities for any Subgroup

For readers who wish to determine the probability of demographic and/or geographic subgroups that the authors did not present probabilities for in the text, the probability of any subgroup can be calculated by summing the relevant probit parameter estimates (listed in this appendix in **TABLE 4**) and then using the NORMDIST function in Microsoft Excel to determine the overall probability. The function "=NORMDIST(B2, 0, 1, TRUE)" should be used where B2 is the cell in which you have placed the summed probit parameter estimates.

When examining **TABLE 4**, remember that the reference characteristics are contained in the constant term and the parameter estimates in the table reflect how any given characteristic is different from the reference group. For example, subgroup 1 for the visits model would be calculated by summing the parameters of the various characteristics plus the constant term: private dental insurance (0.412), year 2003 (2003 x 0.155=310.465), male (in constant term), aged 45-54 (-0.039), white (in constant term), post-college education (0.434), family income 300 percent or greater than the federal poverty threshold (0.329), excellent health (0.194), married (in constant term), born in the United States (in constant term), living in Alameda County (in constant term), constant term (-309.917). This equals 1.878 which yields a probability of 0.970 when put into an Excel spreadsheet using the formula above.

TABLE 4

Demand for Dental Care and Being Unable to Afford Needed Dental Care (Probit Parameter Estimates)

Variables	Demand for Care	Unable to Afford
DENTAL INSURANCE		
No insurance	reference	reference
Private	0.412	-0.574
Denti-Cal	0.318	-0.421
FEDERAL POVERTY THRESHOLD		
0-99% of FPT	reference	reference
100% to 199% of FPT	0.027	0.009
200% to 299% of FPT	0.117	-0.139
300% or higher of FPT	0.329	-0.549
GENDER		
Male	reference	reference
Female	0.155	0.169
AGE		
18 – 24	reference	reference
25 – 34	-0.239	0.305
35 – 44	-0.135	0.240
45 – 54	-0.039	0.229
55 – 64	0.058	0.031
65 – 74	0.061	-0.271
75 or older	0.08	-0.717
RACE/ETHNICITY		
White	reference	reference
Black	-0.11	0.120
Asian/Pacific Islander	-0.035	-0.142
Hispanic	0.018	0.036
Other race	-0.184	0.134

TABLE 4 CONTINUES ON 547

TABLE 4 CONTINUED FROM 546

EDUCATION		
Less than high school	reference	reference
High school	0.125	-0.018
Some post-high school	0.198	0.051
College graduate	0.318	-0.094
Post-college	0.434	-0.215
GENERAL HEALTH STATUS		
Good	reference	reference
Excellent	0.194	-0.270
Very good	0.108	-0.135
Fair	-0.065	0.177
Poor	-0.2	0.327
MARITAL STATUS		
Married	reference	reference
Unmarried	-0.124	0.145
BIRTHPLACE		
U.S.-born	reference	reference
Foreign-born	-0.004	0.122
YEAR		
2001	reference	-
2003	0.155	-
COUNTIES		
Alameda	reference	reference
Alpine	-0.268	N/AV1
Amador	0.056	0.028
Butte	-0.059	-0.035
Calaveras	-0.007	-0.129
Colusa	0.016	-0.181
Contra Costa	0.069	-0.082
Del Norte	-0.168	0.057
El Dorado	0.022	0.141
Fresno	-0.053	-0.182
Glenn	0.054	-0.085
Humboldt	-0.065	-0.079
Imperial	-0.168	-0.290
Inyo	0.098	-0.002
Kern	-0.151	0.102
Kings	-0.052	-0.094
Lake	-0.109	0.004
Lassen	-0.12	-0.045
Los Angeles	-0.021	-0.048
Madera	0.009	0.092
Marin	0.179	-0.015
Mariposa	0.009	0.472
Mendocino	0.068	-0.307
Merced	-0.136	-0.228
Modoc	-0.062	-0.019
Mono	-0.043	-0.241
Monterey	0.058	-0.108
Napa	0.051	0.005
Nevada	-0.027	0.114
Orange	0.013	-0.017
Placer	0.094	0.023
Plumas	0.068	-0.019
Riverside	-0.096	-0.033
Sacramento	0.032	-0.036
Santa Barbara	-0.027	0.186
Santa Clara	-0.093	-0.04
Santa Cruz	-0.036	-0.049
San Benito	0.022	-0.061
San Bernardino	-0.04	0.027
San Diego	0.072	-0.017
San Francisco	0.058	-0.023
San Joaquin	0.045	-0.051
San Luis Obispo	0.149	-0.117
San Mateo	0.062	0.164
Shasta	-0.049	0.002
Sierra	-0.033	-1.147
Siskiyou	-0.023	-0.059
Solano	0.061	-0.149
Sonoma	0.067	-0.097
Stanislaus	-0.083	0.092
Sutter	-0.078	0.082
Tehama	-0.193	-0.054
Trinity	-0.109	-0.478
Tulare	-0.06	0.059
Tuolumne	0.035	-0.327
Ventura	0.09	-0.225
Yolo	0.136	-0.252
Yuba	-0.093	0.02
Constant	-309.917	-0.727
Observations	98,100	42,043

The Alpine County parameter could not be estimated due to an insufficient number of observations. As a result, the Alpine County observations were excluded.

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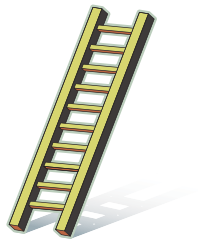

The Effect of Functional Limitations on the Demand for Dental Care Among Adults 65 and Older

TIMOTHY T. BROWN, PHD; YEVGENIY GORYAKIN, PHD; AND TRACY L. FINLAYSON, PHD

ABSTRACT In California, adults living in the community who have two or more of six functional limitations in activities of daily living outnumber adults who live in skilled nursing, intermediate care, and congregate living facilities by almost 2:1. In 2003, approximately 106,000 elderly women living in the community experienced two or more limitations in activities of daily living and were thus 40 percent less likely to access dental care relative to elderly women with fewer limitations.

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As individuals age their need for dental care often increases. The need for dental care, defined as the amount of dental care required to restore an individual to the best possible oral health, is distinct from the demand for dental care, defined as the amount of dental care for which an individual is willing and able to pay. Unfortunately, the two often diverge. The amount of dental care that individuals are willing and able to pay for is often less than the amount required to restore these same individuals to the best possible oral health. Beyond this difference is the distinction between the amount of dental care for which individuals are willing and able to pay and the amount of dental care that they are physically able to access. As individuals move into older adulthood, they are more likely to experience a growing number of functional limitations that prevent them from accessing dental services, even those dental services for which they are willing and able to pay.

A functional limitation can be defined as needing special equipment or the help of another person to perform activities of daily living, ADLs, which include walking, getting in and out of beds and chairs, bathing, dressing, eating, and using the toilet.[1] In California, limitations in two of six ADLs is one of three ways that qualifies an individual to receive benefits under both tax-qualified and nontax-qualified long-term care plans.[2] A similar set of limitations may also qualify Medi-Cal recipients to enter intermediate care facilities.[3]

In California, approximately 92,000 individuals were living in skilled nursing, intermediate care, and congregate living

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facilities at the end of 2003.[4] However, the population of individuals aged 65 or older who live in the community (not in skilled nursing, intermediate care, or congregate living facilities) and who have two or more such limitations included more than 163,000 individuals in 2003, according to the authors' analysis of data from the California Health Interview Survey. What is the impact of these functional limitations on the ability of these individuals to access dental care?

The answer to this question is critical. Relative to younger individuals, the elderly are at increased risk for oral diseases associated with age-related physiologic changes.[5,6] Poor oral health that causes problems with chewing and eating can be particularly serious as such problems can make good nutritional status much more difficult to achieve. Individuals who are missing teeth or who are edentulous may limit the types of food they eat to soft foods, potentially limiting the nutritional content of their food. This can contribute to both poor nutritional status and to unintended weight loss.[5] For example, Atchison and Dolan found that among Medicare enrollees in California, 10 percent needed to limit the types of food they ate and 13 percent had trouble biting or chewing.[7]

In addition, many health conditions are associated with infectious diseases. Oral diseases are infectious, and oral health status can affect and be affected by other health problems. Much recent research focuses on how periodontal diseases interact and are associated with other common conditions through various inflammatory processes. Periodontal disease has been shown to be associated with many diseases that affect the elderly including heart disease, stroke, osteoporosis, pneumonia, and diabetes.[8-18]

Moreover, a number of studies also suggest that conditions such as heart disease and stroke, diabetes, and respiratory disease can actually be improved by regular periodontal care. This suggests a role for dental care in the medical management of these conditions.

Periodontal treatment interventions have been shown to help diabetic individuals with glycemic control management.[19-22] Periodontal treatment interventions have also been shown to be associated with a reduction in risk factors for cardiovascular disease.[23-27] There is also good evidence that professional oral health care and improved oral hygiene results in a slowing of the progression or even occurrence of respiratory disease in the elderly.[28]

PERIODONTAL DISEASE has been shown to be associated with many diseases that affect the elderly including heart disease, stroke, osteoporosis, pneumonia, and diabetes.

However, none of the benefits of dental care can be realized unless those who need them are able to access appropriate dental care. While there has been limited research showing the negative effect of functional limitations on access to dental care among the elderly in California, focusing on the city of Santa Monica, there has been no systematic analysis to date on the effect of functional limitations on the demand for dental care among the elderly in California using statewide data.[29] In this paper, the authors present their findings on the effect of functional limitations on the demand for dental care using the latest available data from the 2003 California Health Interview Survey.

Methods

Data

This analysis uses data from the California Health Interview Survey (CHIS) for the year 2003.[30] The CHIS is a state-level health survey that focuses on public health and access to health care. It is the largest state-level survey conducted in the United States and is designed to produce statistically reliable state-level and county-level estimates. Data were collected from adults aged 18 and older through a random digit dial telephone survey. The 2003 CHIS sample size was 42,044. After the authors restricted their analysis to those 65 years or older, the final sample size became 8,668 (3,294 males and 5,374 females).

Statistical Analysis

The CHIS was collected using a complex survey design. Thus, making accurate inferences about the population the sample was drawn from requires the use of probability weights and replication weights. The authors used Stata 9.2 and the jackknife replication method to incorporate probability weights and replication weights into the calculation of descriptive statistics and the estimation of logistic regression models. The inclusion of variables in the logistic models was based on the economic theory of demand. As a result, they do not contain information on supply factors. Simultaneous equation models of demand and supply could be constructed but are beyond the scope of this analysis. Such models are topics for future research.

The authors' models estimated the association of having a visit to a dental professional at least once during the previous 12 months with age, race/ethnicity, education, family income, marital status, birthplace, general health status,

dental insurance status, family size, and whether a person was experiencing limitations in two or more ADLs. Since the authors' main variable of interest, ADLs, is self-reported, it is important that it be reliable. Studies examining self-reported data on ADLs gathered via telephone have found them to be reliable.[31,32]

Results

TABLE 1 shows the composition of the authors' sample, appropriately adjusted for the complex survey design of the CHIS. To put the following numbers (reported as proportions) in context, the California Department of Finance estimated that there were 3.8 million people aged 65 and older in 2003. There are slightly more women (0.56) than men (0.44) in this sample consistent with the lower life expectancy of men relative to women. The age distribution of the sample shows that a smaller proportion of the sample is in a given category as the categories move up the age continuum: ages 65-69 (0.28); ages 70-74 (0.24); ages 75-79 (0.21); ages 80-84 (0.17); ages 85 and older (0.10).

The racial/ethnic mix is distributed as follows: white (0.67); black (0.05); Asian/Pacific Islander (0.11); Hispanic (0.15); and other race (0.02). Education is distributed in the following way: less than high school (0.24); high school (0.24); some post-high school training (0.24); college graduate (0.15); and graduate school (0.13). Family income, measured as a percentage of the federal poverty threshold, showed that more than half the population is in a family whose income is less than 300 percent of the federal poverty threshold. The distribution is as follows: 0-99 percent federal poverty threshold (0.12); 100-199 percent federal poverty threshold (0.23); 200-299 percent federal poverty threshold (0.18); 300 percent of federal poverty threshold and above (0.46). More than half of the sample (0.56) is married. More than three-quarters of the sample (0.77) was born in the United States.

The general health status of the sample is distributed normally. The sample consists of individuals in poor health (0.11); fair health (0.23); good health (0.29); very good health (0.24); and excellent health (0.12).

Almost half of the sample (0.45) had no dental insurance. Of those with dental insurance, almost one-third had private dental insurance (0.33), while the remainder was covered by Denti-Cal (0.21).

Family size is important when considering the demand for dental care among the elderly as those with larger families may have more individuals available to help them visit a dental professional, should they wish to do so. Almost one-third of individuals lived alone (0.32), while the remaining live with one other person (0.53), two or three other people (0.15), or four or more other people (0.05).

Finally, with regard to the authors' key variable of interest, the number of limitations a person has in ADLs, 4

TABLE 1

Descriptive Statistics

Variables	Proportions
GENDER	
Male	0.44
Female	0.56
AGE	
65 - 69	0.28
70 - 74	0.24
75 - 79	0.21
80 - 84	0.17
85 and older	0.10
RACE	
White	0.67
Black	0.05
Asian/Pacific Islander	0.11
Hispanic	0.15
Other	0.02
EDUCATION	
Less than high school	0.24
High School	0.24
Some post-high school	0.24
College graduate	0.15
Graduate school	0.13
FAMILY INCOME (% OF THE FEDERAL POVERTY THRESHOLD [FPT])	
0-99% of FPT	0.12
100% to 199% of FPT	0.23
200% to 299% of FPT	0.18
300% or higher of FPT	
MARITAL STATUS	
Married	0.56
Unmarried	0.44
BIRTHPLACE	
U.S.-born	0.77
Foreign-born	0.23
GENERAL HEALTH STATUS	
Poor	0.11
Fair	0.23
Good	0.29
Very good	0.24
Excellent	0.12
DENTAL INSURANCE	
Private	0.33
Denti-Cal	0.21
No insurance	0.45
FAMILY SIZE	
1	0.32
2	0.53
3 or 4	0.15
5 or more	0.05
ACTIVITIES OF DAILY LIVING (ADLS)	
Less than two limitations in ADLs	0.96
Two or more limitations in ADLs	0.04
Observations	8,668

All proportions are calculated using probability weights to account for the complex survey design of the 2003 California Health Interview Survey.

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percent of the population aged 65 and older suffers from two or more limitations. The remaining 96 percent suffer from one or no such limitations. It is important to remember that 4 percent of this population includes approximately 163,000 individuals (in 2003).

TABLES 2A, 2B AND 3 present the authors' findings for men and women, respectively. The table includes both the odds-ratio and the marginal probability that a person with a given characteristic accessed dental care in the last year relative to the average person in the sample. The authors will refer to the odds-ratio in the text. The marginal probabilities are presented in order to provide a measure of the magnitude associated with each odds-ratio.

One major finding is that women with two or more limitations in ADLs are 40 percent less likely to access dental care relative women with one or fewer such limitations (odds-ratio [OR]=0.601; confidence interval [CI], 0.393-0.918). There is no such finding for men. The reason for this is likely found in the results on general health status and dental visits. Compared to those in poor health, only men who are in excellent health (OR=2.220; CI, 1.263-3905) or very good health (OR=1.666; CI, 1.112-2.496) are more likely to access dental care than the average man in the population.

This is in strong contrast to the behavior of women. Compared to those in poor health, women with any level of health above poor health are more likely to access dental care whether they have fair health (OR=1.660; CI, 1.216-2.266); good health (OR=1.709; CI, 1.233-2.369); very good health (OR=2.271; CI, 1.608-3.206); or excellent health (OR=2.443; CI-1.664, 3.585).

Aside from health concerns, elderly men and women behave similarly with respect to private dental insurance, but very differently with respect to Denti-Cal. Elderly men and women who have private dental insurance are about 50 percent more likely to have visited a dental professional in the last year than those without dental insurance (men: OR=1.572; CI, 1.284-1.924; women: OR=1.484; CI, 1.225-1.798).

In contrast, elderly women with Medi-Cal who know they have Denti-Cal are no more likely to have visited a dental professional than women who are uninsured, while men with Medi-Cal who know they have Denti-Cal are about as likely to have visited a dental professional as men with private insurance (OR=1.712; CI, 1.208-2.426). However, elderly women who have Medi-Cal and do not know they have Denti-Cal are a third less likely to have visited a dental professional in the last year relative to women who have no dental insurance (OR=0.666; CI, 0.494, 0.898). Elderly men who have Medi-Cal and do not know they have Denti-Cal are no more likely to have visited a dental professional in the last year than those who have no dental insurance.

ELDERLY MEN AND WOMEN who have private dental insurance are about 50 percent more likely to have visited a dental professional in the last year than those without dental insurance.

TABLE 3 presents the probabilities of visiting a dental professional for four subgroups of individuals. These are not the only subgroups that could have been chosen, but portray various groups of individuals in California. We purposively do not simply vary only one characteristic in presenting these subgroups. The change in the probability of accessing care due to a change in any one characteristic can be seen by examining the marginal probabilities in **TABLES 2A, 2B AND 3.**

The characteristics of each subgroup and each subgroup's probability of accessing dental care are as follows: (1) private dental insurance, male, aged 65-69, white, college graduate, family income 300 percent or greater than the federal poverty threshold, very good health, married, U.S.-born, family size of three or four, one or fewer limitations on ADL (probability=0.90; CI 0.83-0.97); (2) Denti-Cal insurance (and knows it) female, aged 65-69, black, high school education, family income less than the federal poverty threshold, poor health, unmarried, U.S.-born, lives alone, two or more limitations on ADL (probability=0.47; CI, 31-65); (3) Denti-Cal insurance (and knows it), male, aged 80-84, Hispanic, less than high school education, family income 100-199 percent of federal poverty threshold, good health, married, foreign-born, family size of two, one or fewer limitations on ADL (probability=0.57; CI, 0.47-0.67); (4) private dental insurance, female, aged 65-69, Asian/Pacific Islander, some college education, family income 300-199 percent of the federal poverty threshold, fair health, married, foreign-born, family size of two, one or fewer limitations on ADL (probability=0.90; CI, 0.81-0.98).

It can be seen that across these subgroups that the difference in the overall probability of having visited a dental professional in the last year varies from 0.47 to 0.90, a 0.43 difference.

Discussion

The analysis shows that women and men behave quite differently with respect to their demand for dental care. Elderly women appear to be far

CONTINUES ON PAGE 556

TABLE 2A

Demand for Dental Care: Men Aged 65 and Older

Variables	Odds Ratio	95% Confidence Interval	Marginal Probability	95% Confidence Interval
DENTAL INSURANCE				
No insurance	reference		reference	
Private	1.572	[1.284, 1.924]	0.092***	[0.052, 0.133]
Medi-Cal, know about Denti-Cal	1.712	[1.208, 2.426]	0.098**	[0.039, 0.157]
Medi-Cal, don't know about Denti-Cal	0.782	[0.538, 1.135]	-0.052	[-0.133, 0.028]
AGE				
65 - 69	reference		reference	
70 - 74	1.047	[0.808, 1.357]	0.009	[-0.042, 0.061]
75 - 79	0.923	[0.681, 1.251]	-0.017	[-0.079, 0.045]
80 - 84	1.137	[0.838, 1.543]	0.025	[-0.033, 0.084]
85 and older	1.088	[0.747, 1.586]	0.017	[-0.056, 0.090]
Race				
White	reference		reference	
Black	0.866	[0.540, 1.390]	-0.030	[-0.130, 0.070]
Asian/Pacific Islander	2.173	[1.391, 3.395]	0.137***	[0.067, 0.206]
Hispanic	2.009	[1.362, 2.964]	0.133***	[0.064, 0.202]
Other	0.723	[0.442, 1.183]	-0.070	[-0.182, 0.041]
EDUCATION				
Less than high school	reference		reference	
High school	1.888	[1.390, 2.565]	0.120***	[0.063, 0.176]
Some post-high school	2.142	[1.505, 3.048]	0.142***	[0.082, 0.201]
College graduate	4.132	[3.036, 5.625]	0.230***	[0.181, 0.279]
Graduate school	4.025	[2.816, 5.754]	0.215***	[0.164, 0.266]
FAMILY INCOME (% OF THE FEDERAL POVERTY THRESHOLD [FPT])				
0-99% of FPT	reference		reference	
100% to 199% of FPT	1.254	[0.801, 1.962]	0.045	[-0.041, 0.130]
200% to 299% of FPT	1.832	[1.137, 2.951]	0.111**	[0.032, 0.190]
300% or higher of FPT	2.735	[1.777, 4.210]	0.204***	[0.113, 0.295]
GENERAL HEALTH STATUS				
Poor	reference		reference	
Excellent	2.220	[1.263, 3.905]	0.145**	[0.057, 0.233]
Very good	1.666	[1.112, 2.496]	0.099**	[0.028, 0.170]
Good	1.455	[0.965, 2.196]	0.074	[-0.002, 0.150]
Fair	1.220	[0.796, 1.870]	0.039	[-0.041, 0.119]
MARITAL STATUS				
Married	reference		reference	
Unmarried	0.976	[0.670, 1.421]	-0.005	[-0.080, 0.070]

TABLE 2A CONTINUES ON 554

TABLE 2A CONTINUED FROM 553

BIRTHPLACE				
U.S.-born	reference		reference	
Foreign-born	0.538	[0.398, 0.728]	-0.126***	[-0.189, -0.063]
FAMILY SIZE				
1	reference		reference	
2	1.597	[1.126, 2.265]	0.091**	[0.029, 0.153]
3 or 4	1.103	[0.705, 1.726]	0.020	[-0.067, 0.107]
5 or more	1.204	[0.673, 2.154]	0.037	[-0.072, 0.146]
ACTIVITIES OF DAILY LIVING (ADLS)				
Less than two limitations in ADLs	reference		reference	
Two or more limitations in ADLs	1.306	[0.676, 2.522]	0.054	[-0.078, 0.187]

TABLE 2B

Demand for Dental Care: Women Aged 65 and Older

Variables	Odds Ratio	95% Confidence Interval	Marginal Probability	95% Confidence Interval
DENTAL INSURANCE				
No insurance	reference		reference	
Private	1.484	[1.225, 1.798]	0.070***	[0.038, 0.103]
Medi-Cal, know about Denti-Cal	1.276	[0.971, 1.676]	0.041	[-0.001, 0.082]
Medi-Cal, don't know about Denti-Cal	0.666	[0.494, 0.898]	-0.079*	[-0.142, -0.016]
AGE				
65 - 69	reference		reference	
70 - 74	0.827	[0.667, 1.025]	-0.035	[-0.074, 0.003]
75 - 79	0.999	[0.768, 1.300]	0.000	[-0.046, 0.046]
80 - 84	1.101	[0.873, 1.389]	0.017	[-0.022, 0.056]
85 and older	1.062	[0.799, 1.411]	0.010	[-0.038, 0.059]
RACE				
White	reference		reference	
Black	0.541	[0.396, 0.740]	-0.124***	[-0.191, -0.056]
Asian/Pacific Islander	1.649	[1.133, 2.399]	0.079**	[0.026, 0.133]
Hispanic	1.161	[0.858, 1.571]	0.026	[-0.025, 0.077]
Other	0.766	[0.524, 1.119]	-0.050	[-0.125, 0.024]
EDUCATION				
Less than high school	reference		reference	
High School	1.230	[0.968, 1.561]	0.036	[-0.003, 0.074]
Some post-high school	1.694	[1.342, 2.139]	0.087***	[0.052, 0.122]
College graduate	1.951	[1.436, 2.650]	0.105***	[0.065, 0.145]
Graduate school	3.239	[2.331, 4.502]	0.160***	[0.124, 0.195]

TABLE 2B CONTINUES ON 555

TABLE 2B CONTINUED FROM 554

FAMILY INCOME (% OF THE FEDERAL POVERTY THRESHOLD [FPT])				
0-99% of FPT	reference		reference	
100% to 199% of FPT	0.842	[0.644, 1.102]	-0.031	[-0.081, 0.018]
200% to 299% of FPT	1.192	[0.919, 1.545]	0.030	[-0.012, 0.072]
300% or higher of FPT	1.790	[1.373, 2.332]	0.103***	[0.058, 0.148]
GENERAL HEALTH STATUS				
Poor	reference		reference	
Excellent	2.443	[1.664, 3.585]	0.136***	[0.087, 0.184]
Very good	2.271	[1.608, 3.206]	0.133***	[0.080, 0.185]
Good	1.709	[1.233, 2.369]	0.089**	[0.038, 0.140]
Fair	1.660	[1.216, 2.266]	0.081***	[0.037, 0.126]
MARITAL STATUS				
Married	reference		reference	
Unmarried	1.475	[1.146, 1.899]	0.070**	[0.026, 0.113]
BIRTHPLACE				
U.S.-born	reference		reference	
Foreign-born	1.149	[0.892, 1.478]	0.025	[-0.019, 0.068]
FAMILY SIZE				
1	reference		reference	
2	0.836	[0.658, 1.063]	-0.032	[-0.075, 0.010]
3 or 4	0.750	[0.568, 0.990]	-0.052	[-0.103, 0.000]
5 or more	0.421	[0.258, 0.687]	-0.172**	[-0.286, -0.059]
ACTIVITIES OF DAILY LIVING (ADLS)				
Less than two limitations in ADLs	reference		reference	
Two or more limitations in ADLs	0.601	[0.393, 0.918]	-0.090*	[-0.165, -0.015]

TABLE 3

Probability of Accessing Dental Care: Selected Subgroups

Subgroups		Probability	95% CI (lower)	95% CI (upper)
Subgroup (1):	Male, aged 65-69, white, college graduate, three- to four-family size, private insurance, family income 300% or greater than the federal poverty line, very good health, married, U.S.-born, two or more limitations in activities of daily living	0.90	0.83	0.97
Subgroup (2):	Female, aged 65-69, black, high school education, lives alone, Denti-Cal (and knows it) family income below of the federal poverty line, poor health, unmarried, U.S.-born, two or more limitations in activities of daily living	0.47	0.31	0.65
Subgroup (3):	Male, aged 80-84, Hispanic, less than high school education, two-person family size, Denti-Cal (and knows it), family income 100-199% of federal poverty line, good health, married, foreign-born, one or fewer limitations in activities of daily living	0.57	0.47	0.67
Subgroup (4):	Female, aged 65-69, Asian/Pacific Islander, some college education, two-person family size, private insurance, family income 300% or greater than the federal poverty line, good health, married, foreign-born, one or fewer limitations in activities of daily living	0.90	0.81	0.98

Petris Center analysis of data from the 2003 California Health Interview Survey.

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more vigilant about visiting a dental professional than elderly men, and will seek care even when they do not have dental insurance, whereas elderly men are less likely to visit a dental professional if they do not have some type of dental insurance. This is consistent with studies of gender differences with respect to health insurance.[33]

It is noted that it is possible that the odds-ratios that describe the relationship between accessing dental care and various types of dental insurance are biased due to potential reverse causation (individuals who are more likely to need to visit a dental professional may be more likely to obtain dental insurance). Although this problem can often be corrected statistically (e.g., using the instrumental variable technique), the authors have been unable to do so due to data limitations.

However, other researchers who have implemented this correction uniformly find that the corrected parameter estimates are higher than the uncorrected parameters estimates.[34-36] The authors therefore consider their estimates to approximate a lower bound of the association of dental insurance and visits to a dental professional.

In contrast, functional limitations limit access to dental care for women much more than men. Women with two or more functional limitations are 40 percent less likely to have visited a dental professional in the last 12 months relative to those who have one or no functional limitations. In other words, women who need special equipment or the assistance of another person in two or more of the following areas are less likely to visit a dental professional than the average women in the sample: walking, getting in and out of beds and chairs, bathing, dressing, eating, and using the toilet. Approximately 106,000 women aged 65 or older were in this category in California according to the authors' analysis of the 2003 CHIS.

This finding is independent of family income, dental insurance, education, age, race, marital status, family size, nation of birth, and general health status. This finding suggests that a key barrier that prevents these individuals from obtaining dental care is physical access or the availability of dental offices that will accept such patients. This problem could be alleviated in a number of ways.

IT IS ALREADY THE CASE that virtually all dentists treat such individuals with dignity, but communicating this to potential patients is critical to reassure those with functional limitations.

One way is to bring dental services to those who need it via a mobile dental clinic. Such clinics are permissible in California and are regulated by the Business and Professions Code and the Health and Safety Code.[37] Mobile dental clinics have been used in California for more than 20 years. The University of Southern California's Mobile Dental Clinic has a long history of successful use with children from low-income families and rural populations.[38-40]

Mobile clinics can also be used for reaching out to elderly with limitations in ADLs. Units can be set up like a dental office so that a patient can sit down and be treated inside, or it can be used to transport portable equipment that can then be set up at a patient's bedside.[41] Another strategy that has been successful with improving access in rural populations that could be applied to the population of elderly with limitations in ADLs would be to coordinate their transportation to and from a local dental office.

A third approach is for a subgroup of dental professionals to make their practices senior friendly by reaching out to the elderly who may suffer from limitations in ADLs. This can be done both by making their practices more accessible to such individuals as well as by reaching out via advertising to individuals who primarily will not come to visit a dental professional due to embarrassment about their condition. Many individuals who suffer from functional limitations may be more than willing to visit a dental professional if they know that the facility is able to accommodate their functional limitation and that they will be seen and treated with dignity. To be sure, it is already the case that virtually all dentists treat such individuals with dignity, but communicating this to potential patients is critical to reassure those with functional limitations.

Given the current computer technology available and trends of more seniors accessing the Internet for information, dental practices can use this technology to better track the health and ADL status of patients as they age and alert elderly patients of their ability to provide ADL accommodations (like portable lifts or other types of needed equipment) through Web sites or newsletter announcements.[41]

Federal- and state-level policy solutions to improving access to dental care for this subgroup should be considered as well. A growing number of the elderly may begin to experience one or more limitations in ADLs with advancing age. California's population is aging, with every county reporting increases in numbers of elderly between 1990 and 2004, especially among those age 85 and older.[42]

The elderly have Medicare to cover most of their health care needs, yet Medi-

care does not cover routine dental care or dental treatments, unless a dental procedure is a critical component for treating a different condition.[43,44] An individual can purchase a separate Medigap plan. In 2002, 17 percent of Medicare enrollees in California also had Medigap.[42] However, Medigap plans vary, most standard plans do not include dental benefits, and they are often prohibitively expensive for many elderly. This population would likely enjoy improved access to dental care if Medicare included dental coverage.

State-level policy strategies should include building California's dental infrastructure and developing a plan to address the elderly population's dental needs, with extra attention paid to those elderly with limitations in ADLs. Oral Health America gave California a "D+" overall infrastructure grade on its report card in 2003, with "Fs" specifically for lacking a state dental director and an oral health plan.[45] A permanent state dental director would help provide leadership and establish and monitor progress on California-specific oral health goals and priorities.

Additional opportunities such as residencies/graduate programs and continuing dental education sessions that provide geriatric training could be offered as part of a statewide effort to prepare the dental workforce for caring for the needs of elderly, particularly the frail elderly and those with limitations in ADLs.[44] There are training and cost implications for each of these potential solutions that are not addressed here that will need to be assessed when deciding to implement any of these strategies to improve access for this population.

Conclusion

Among elderly females, having two or more functional limitations is associated with being approximately 40 percent less likely to visit a dental professional relative to the average elderly female. Approximately 106,000 individuals in California are in this category as of 2003, larger than the entire population of individuals in skilled nursing, intermediate care, and congregate living facilities. Policymakers, both public and private, should consider how to aid such individuals in obtaining dental care.

Individual practitioners should also consider implementing simple practice changes to help increase access to care for elderly patients with functional limitations, such as purchasing equipment that will make their offices more accessible and comfortable places to visit, and perhaps providing some services through mobile dental clinics. ■■■■

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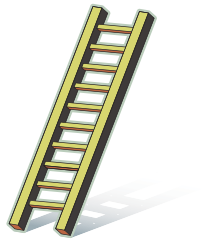

Adult Oral Health Status in California, 1995-2006: Demographic Factors Associated With Tooth Loss Due to Disease

TRACY L. FINLAYSON, PHD; TIMOTHY T. BROWN, PHD; BRENT D. FULTON, PHD; AND SALAR JAHEDI, PHD

ABSTRACT The most recent 2006 estimates indicate that 60 percent of California adults did not experience tooth loss due to disease. However, about 39 percent were missing one or more teeth due to disease, and another 1 percent were edentulous. In an 11-year (1995-2006) pooled multivariate analysis, California adults who were older, less educated, racial/ethnic minorities, current or former smokers, or had lower annual incomes were more likely to be missing teeth. .

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Tooth loss due to disease and pain from preventable dental problems can have dramatic negative long-term effects on oral health and quality of life due to decreased ability to function and perform important everyday activities like chewing, eating, smiling, laughing, and talking. Oral diseases are progressive, chronic diseases, and if not detected and treated in the early stages, may become more difficult, painful, and costly to treat.[1] Advanced oral disease can result in tooth loss, or, in some cases, edentulism.

Despite the improvements in the nation's oral health in recent decades overall, significant levels of oral diseases still persist and are concentrated among the socioeconomically disadvantaged, many racial/ethnic minority groups, and the elderly.[1-3] While tooth loss due to disease has also generally declined, not all adults have been able to retain all their natural teeth.[4-6]

The United States has set several goals with specific targets to promote the nation's oral health, improve quality of life, and work to eliminate disparities. Healthy People 2010 Oral Health Objective No. 21-13 specified the need to increase the proportion of adults to 42 percent who have never had a permanent tooth extracted because of dental caries or periodontal disease.[7]

Baseline estimates indicated that only 31 percent of adults aged 35 to 44 years never had a permanent tooth extracted because of dental caries or periodontal disease in 1988-94. There is a need for current, state-specific empirical evidence assessing adult oral health and tooth loss to monitor California's progress in reaching the 2010 goals, and inform the establishment of new Healthy People 2020 goals.

Although it would be ideal to assess every adult's overall oral health status through clinical evaluations by a licensed dentist, this approach is prohibitively expensive and impractical when surveying such large population groups like the state of California.[8] Instead, a simple measure of oral health that can be accurately determined in telephone surveys and gives a good approximate picture of the oral health of a population is used. This measure is the self-reported number of teeth that an adult is missing due to disease.

A study by Lang et al. compared the measure of teeth missing due to disease with the Oral Health Status Index, OHSI, that combines information from a clinical examination of the teeth and the periodontium into an overall score of -54 to 100.[9] This OHSI was developed by Marcus et al. and validated in both general and minority populations.[10,11] Lang et al. found that the measure of missing teeth, a component of the OHSI, performed almost as well as the OHSI.[9] Additionally, collecting self-reported information about dentition via telephone has been validated among samples of adults over the age of 45 and elderly over the age of 70.[12,13]

The number of missing teeth due to disease is measured in the Behavioral Risk Factor Survey, BRFS. Recent age-adjusted California-specific estimates of missing teeth used 2002 and 2004 BRFS data and focused on the elderly, adults aged 65 and over. In 2002, California was among the top three states nationwide in terms of retention, with 60.5 percent of elderly retaining most of their natural teeth (defined in that analysis as losing five or fewer teeth to disease) and only a 13.3 percent edentulism rate.[6] The National Oral Health Surveillance System, NOHSS, estimated that 36.3 percent of California's elderly were missing six or more teeth due to disease, and a 13.8 percent edentulism rate in 2004.[14] However, more detailed current oral health status information about the entire California adult population that can account for the effects of financial and sociodemographic factors is needed.

PAST STUDIES INDICATE that tobacco use increases the risk of tooth loss over time, and cross-sectional comparisons show that smokers tend to have fewer teeth than their nonsmoking adult counterparts.

Several factors have been associated with tooth loss in the literature. In 10-year longitudinal studies in two cities, Copeland et. al. reported that baseline percentage of restored teeth, pocket depth, age, tobacco use, alcohol consumption, number of teeth present, and male gender were predictors of tooth loss, yet there were differences by population.[15] In another study analyzing data from the Third National Health and Nutrition Examination Survey, NHANES III, Marcus et. al. reported that age and race/ethnicity were related to tooth loss and retention, with non-Hispanic blacks generally experiencing the highest rates of loss.[4]

Californians are an especially socioeconomically and demographically diverse group. In order to accurately understand the oral health of Californians this diversity must be taken into account. To do so, the authors used statistical techniques that allowed for the examination of the relationship between oral health and key sociodemographic characteristics of individuals. The California BRFS also includes information on behaviors and health risk factors. Smoking status was also examined as an oral health risk factor in the models. Past studies indicate that tobacco use increases the risk of tooth loss over time, and cross-sectional comparisons show that smokers tend to have fewer teeth than their nonsmoking adult counterparts.[15-17]

This paper presents estimates of the probabilities in each category of adults in California missing teeth due to disease (no missing teeth, missing one to five teeth, missing six more teeth (but not all), and edentulous) using all available data over an 11-year span (using seven years of data), as well as examines the factors associated with varying levels of tooth loss, a proxy for oral health status.

Methods

The authors analyzed California Behavioral Risk Factor Survey, BRFS, data, a survey designed by the U.S. Centers for Disease Control and Prevention to produce reliable state-level estimates of behaviors that are associated with premature morbidity and mortality. Oral health questions are an optional module in the BRFS and are not required to be included by states every year. The authors analyzed data for the years 1995, 1997, 1999, 2000, 2002, 2004, and 2006, all years in the last 11-year period which included oral health information. Data were collected from adults

aged 18 and older through a monthly random digit dial telephone survey.

The California BRFS has a sample size of about 4,000 per year, giving a total sample size of 27,693 adults across the 11-year period. Pooling the data across the seven available years provided more statistical power for multivariate analyses, and enabled the detection of trends over a period of time or significant changes in a given year. The year 1995 was selected as the baseline in the pooled analyses. Additional detailed information about the California survey and data collection methods are available elsewhere.[18]

The number of missing teeth due to disease was the main measure of oral health status for the population for adults in California. The BRFS survey question asked "How many of your permanent teeth have been removed because of tooth decay or gum disease? Include teeth lost to infection, but do not include teeth lost for other reasons, such as injury or orthodontics." The measure of missing teeth due to disease used in this study thus excluded teeth removed in the course of orthodontic treatment, teeth removed due to injury, and wisdom teeth removed for reasons other than tooth decay and gum disease. The data allowed for four levels of oral health analysis with regard to missing teeth: (1) no missing teeth, (2) one to five missing teeth, (3) missing six teeth or more, but not all, and (4) all teeth missing (edentulism). The few cases who refused to answer or did not know how many teeth they lost to disease were excluded.

The sociodemographic characteristics used in the analysis were as follows: age intervals (18-24, 25-34; 35-44; 45-54; 55-64, 65-74, and 75 or greater), gender (male, female), race/ethnicity (white, Asian/Pacific Islander, Hispanic, black, or other race), marital status (unmarried, married), smoking status (never, current, former smoker), annual household income intervals (less than $10,000, $10,000-14,999, $15,000-19,999, $20,000-24,999, $25,000-34,999, $35,000-49,999, $50,000-74,999, $75,000 or more), household size (one, two, three, or four or more) and education status (less than high school, high school graduate, post-high school training, college graduate, post-college).

The authors estimated the independent probability of each of sociodemographic characteristic being associated with the number of teeth a person was missing using ordered probit regression models for the 11-year pooled sample of 1995-2006 data. All analyses were conducted using Stata 9.2 statistical software and incorporated probability weighting.[19] Probability weights were standardized to the population of California according to the 2000 U.S. Census using weights supplied by the Survey Research Group, which is a section under the California Department of Public Health's Chronic Disease Surveillance and Research Branch. SRG is also a program of the Public Health Institute.

THE NUMBER OF missing teeth due to disease was the main measure of oral health status for the population for adults in California.

The actual ordered probit output that reports a single equation along with multiple cut-points (one less the number of ordered categories) is not reported since it is not immediately interpretable. Rather, the authors used the ordered probit coefficients and the appropriate cut-points to compute marginal probabilities on a scale from 0 to 1 (so a marginal probability of, for example, 0.05, implies a five percentage points increase in the probability that a person is included in the category of missing teeth being examined). That is to say, if being older increases the probability of having missing teeth by 5 percentage points, it does so for the person of average income, race, and other demographics. It does not take into account that older people may subsequently have more money and are predominantly of one gender.

Marginal probabilities were computed at the mean of the other independent variables. These estimates were used to then predict the overall probabilities of four select sociodemographic subgroups of adults missing one to five teeth or six or more, but not all teeth. These diverse subgroups were constructed for illustrative purposes to emphasize the variation in tooth loss among California adults of different sociodemographic backgrounds using data only from 2006. These are not the only subgroups that could have been chosen, but portray various groups of individuals in California. We purposively do not simply vary only one characteristic in presenting these subgroups, and selected different subsets of characteristics.

Results

Analysis of the most current single year, 2006, California BRFS data showed that approximately 40 percent of adults in the state suffer from reduced oral health status, that is, they are missing one or more teeth due to disease. Approximately 1 percent are edentulous, suffering the loss of all teeth. Another 5 percent suffer from the loss of six or more, but not all, teeth. Finally, approximately 33 percent suffer from the loss

of one to five teeth. TABLE 1 presents the weighted means for the entire sample (years 1995, 1997, 1999, 2000, 2002, 2004, and 2006). Tooth loss estimates across the entire sample over the 11-year span were slightly higher, with about 44 percent of adults suffering from reduced oral health status. A higher proportion were edentulous (3.64 percent), just over 9 percent lost six or more teeth, and about 31 percent of adults were missing one to five teeth during the study period.

TABLE 2 presents the probabilities that adults in California with different characteristics will have differing numbers of teeth missing due to disease. In the analysis that follows, several socioeconomic and smoking behavior variables are related to each of the following dependent variables: (1) no missing teeth, (2) one to five missing teeth, (3) six or more missing teeth (but not all), and (4) all missing teeth. For each socioeconomic variable, a reference group is omitted. Each value for the socioeconomic variable should be understood as the probability (in percentage points) that a person of that characteristic will be missing teeth relative to the reference group. For example, for the socioeconomic variable "sex," "male" has been omitted. This means the coefficient reported for female should be interpreted as the additional probability (in percentage points) that females of a certain characteristic are missing teeth as compared to the reference group.

In column 2 of TABLE 2, the authors found that, in general, the older a person is, the more likely they are to have lost one to five teeth due to disease. Those aged 25 to 34 are 12.6 percentage points more likely, those 35 to 44 are 18.0 percentage points more likely, those aged 45-54 are 17.1 percentage points more likely, and those aged 55 to 64 are 7.3 percentage points more likely than those aged 18-24 (the reference group) to have lost one to five teeth due to disease. Those 65 and older are not more likely than those aged 18-24 to have lost one to five teeth due to disease. Of course, this is not because the teeth of adults over age 65 are as healthy as those in the reference group — but because adults over age 65 tend to experience more tooth loss and be in the next and more severe category, loss of six or more (but not all) teeth due to disease.

In column 3 of TABLE 2, the authors found, even more so than above, that the older a person is, the more likely they are to have lost six or more teeth (but not all) due to disease. Those aged 25 to 34 are 7.4 percentage points more likely, those 35 to 44 are 13.6 percentage points more likely, those aged 45-54 are 20.9 percentage points more likely, those aged 55 to 64 are 27.3 percentage points more likely, those aged 65 to 74 are 28.7 percentage points more likely, and those aged 75 and older are 27.7 percentage points more likely than those aged 18-24 to have lost six or more teeth (but not all) due to disease.

Compared to the white reference group, every other racial/ethnic group

TABLE 1

Weighted Sample Proportions, 1995-2006 California Behavorial Risk Factor Survey

Variables	Weighted sample proportions
GENDER	
Male	49.33%
Female	50.67%
AGE GROUP	
18-24	13.70%
25-34	20.88%
35-44	21.98%
45-54	17.72%
55-64	11.23%
65-74	8.49%
75+	6.00%
RACE/ETHNICITY	
White	51.81%
Black	6.29%
Asian/Pacific Islander	11.23%
Hispanic	28.21%
Other	2.46%
EDUCATION	
Less than high school	16.36%
High school diploma	24.12%
Some post-high school	27.60%
College graduate	20.37%
Post-college	11.55%
ANNUAL HOUSEHOLD INCOME	
< $10,000	10.00%
$10,000-$14,999	8.24%
$15,000-$19,999	7.52%
$20,000-$24,999	7.81%
$25,000-$34,999	11.86%
$35,000-$49,999	15.04%
$50,000-$74,999	16.49%
$75,000 and above	23.03%
HOUSEHOLD SIZE	
One	12.34%
Two	28.66%
Three	18.27%
Four or more	40.70%
MARRIED	
Yes	60.96%
No	39.04%
SMOKER STATUS	
Never	57.57%
Current	16.94%
Former	25.49%
TEETH MISSING	
None	55.80%
1 to 5	31.44%
6 or more (but not all)	9.11%
All	3.64%

considered was more likely to be missing teeth due to disease. In column 2, **TABLE 2**, blacks are 8.4 percentage points more likely, Asian/Pacific Islanders are 10.3 percentage points more likely, Hispanics are 1.4 percentage points more likely, and those of other races are 6.5 percentage points more likely than whites to be missing one to five teeth. In column 3, **TABLE 2**, blacks are 4.8 percentage points more likely, Asian/Pacific Islanders are 6.2 percentage points more likely, Hispanics are 0.6 percentage points more likely, and those of other races are 3.6 percentage points more likely than whites to be missing six or more (but not all) teeth.

Education is also associated with tooth loss due to disease, and a social gradient is apparent. With increasing education, there is a decreasing likelihood of tooth loss due to disease. High school graduates were 3.0 percentage points less likely, those who have attended some college are 7.5 percentage points less likely, and those who have graduated from college are 11.5 percentage points less likely, and those who have post-college education are 14.6 percentage points less likely to have lost one to five teeth due to disease relative to those with less than high school education. In column 3, **TABLE 2**, high school graduates are 1.2 percentage points less likely, those who have attended some college are 2.8 percentage points less likely, and those who have graduated from college are 4.0 percentage points less likely, and those who have post-college education are 4.5 percentage points less likely to have lost six or more (but not all) teeth due to disease relative to those with less than high school education.

Annual income is related with the loss of teeth due to disease. Only those individuals with family incomes greater than $25,000 annually are less likely to be missing teeth due to disease. As with education, there is an inverse relationship between annual income and likelihood of tooth loss that follows a social gradient pattern. Those earning in the $25,000-34,999 range annually are less likely to be missing one to five (5.1 percentage points) or six or more teeth (but not all) (1.9 percentage points) relative to those whose family income is less than $10,000 annually (reference group).

Those earning in the $35,000-49,999 range annually are less likely to be missing one to five (9.0 percentage points) or six or more teeth (but not all) (3.2 percentage points) relative to those in the reference group. Those in the next highest income bracket of $50,000-74,999 are less likely to be missing one to five (10.1 percentage points) or six or more teeth (but not all) (3.5 percentage points) relative to those in the reference group. The high end of the income range, those earning $75,000 and above annually are less likely to be missing one to five (15.1 percentage points) or six or more teeth (but not all) (5.1 percentage points) relative to those in the reference group.

ONLY THOSE individuals with family incomes greater than $25,000 annually are less likely to be missing teeth due to disease.

Finally, smoking, both current smokers and former smokers, is associated with the loss of teeth due to disease. In columns 2 and 3 of **TABLE 2**, current smokers are far more likely than former smokers to have lost six or more (but not all) teeth. Current smokers are 10.2 percentage points more likely, while former smokers are only 6.4 percentage point more likely to have lost one to five teeth relative to those who have never smoked. Current smokers are 5.9 percentage points more likely, while former smokers are only 3.0 percentage point more likely than those who have never smoked to have lost six or more teeth (but not all) relative to those who have never smoked.

No significant associations were found for household size, marital status, or the year variables in the regression models.

Next, the authors assessed the variation in oral health status across four different specific socioeconomic subgroups of adults in 2006 the pooled ordered probit model. These subgroups are for purposes of illustration only and were chosen to show the diversity in the likelihood of missing teeth across different groups and help understand the socioeconomic variation.

The first subgroup was made up of white males, aged 45-54, who have post-college education, have incomes in the $50,000-74,999 range, have never smoked, and are married. The second subgroup was made up of black females, aged 25-34, who have a high school education, incomes between $35,000-49,999, are current smokers, and are unmarried. The third subgroup was made up of Hispanic males, aged 35-44, who have less than a high school education, incomes between $10,000-14,999, are current smokers, and are married. The final subgroup was made up of Asian females, aged 65-74, who have some college education, incomes between $20,000-24,999, have never smoked, and are unmarried.

As can be seen in **TABLE 3**, these subgroups vary a great deal in the overall probability that will they fall into a given category with regard to missing teeth.

TABLE 2

Pooled CA BRFS Model (1995-2006), 1995 as Base Year Marginal Probability (Standard Error)

Characteristics	Column (1) No Missing Teeth	Column (2) Missing 1-5 Teeth	Column (3) Missing 6+ But Not All	Column (4) Missing All Teeth
Female	-0.0237***	0.0155***	0.00658***	0.00161***
	(0.0081)	(0.0053)	(0.0022)	(0.00056)
Age 25-34	-0.222***	0.126***	0.0736***	0.0225***
	(0.018)	(0.0087)	(0.0070)	(0.0029)
Age 35-44	-0.367***	0.180***	0.136***	0.0510***
	(0.016)	(0.0058)	(0.0079)	(0.0045)
Age 45-54	-0.487***	0.171***	0.209***	0.107***
	(0.014)	(0.0047)	(0.0091)	(0.0080)
Age 55-64	-0.564***	0.0731***	0.273***	0.218***
	(0.010)	(0.010)	(0.0085)	(0.014)
Age 65-74	-0.594***	-0.0212	0.287***	0.328***
	(0.0076)	(0.013)	(0.0077)	(0.019)
Age 75+	-0.590***	-0.0847***	0.277***	0.397***
	(0.0063)	(0.014)	(0.0081)	(0.021)
Black	-0.146***	0.0835***	0.0483***	0.0144***
	(0.015)	(0.0075)	(0.0061)	(0.0022)
Asian/Pacific Islander	-0.184***	0.103***	0.0619***	0.0190***
	(0.016)	(0.0070)	(0.0067)	(0.0026)
Hispanic	-0.0220**	0.0143**	0.00619*	0.00154*
	(0.011)	(0.0071)	(0.0032)	(0.00080)
Other race/ethnicity	-0.111***	0.0654***	0.0358***	0.0103**
	(0.034)	(0.017)	(0.012)	(0.0042)
High school	0.0444***	-0.0297***	-0.0119***	-0.00284***
	(0.014)	(0.0094)	(0.0036)	(0.00086)
Some post-high school	0.110***	-0.0746***	-0.0286***	-0.00664***
	(0.014)	(0.0095)	(0.0034)	(0.00084)
College graduate	0.164***	-0.115***	-0.0402***	-0.00890***
	(0.015)	(0.011)	(0.0033)	(0.00085)
Post-college	0.200***	-0.146***	-0.0452***	-0.00938***
	(0.015)	(0.012)	(0.0030)	(0.00074)
$10,000-$14,999	-0.0285	0.0183	0.00816	0.00207
	(0.020)	(0.013)	(0.0060)	(0.0016)
$15,000-$19,999	0.0135	-0.00890	-0.00368	-0.000887
	(0.018)	(0.012)	(0.0049)	(0.0012)
$20,000-$24,999	0.0161	-0.0107	-0.00438	-0.00105
	(0.017)	(0.012)	(0.0047)	(0.0011)

TABLE 2 CONTINUES ON 567

TABLE 2 CONTINUED FROM PAGE 566

$25,000-$34,999	0.0741***	-0.0507***	-0.0190***	-0.00434***
	(0.016)	(0.012)	(0.0039)	(0.00083)
$35,000-$49,999	0.129***	-0.0903***	-0.0317***	-0.00699***
	(0.015)	(0.011)	(0.0033)	(0.00074)
$50,000-$74,999	0.144***	-0.101***	-0.0351***	-0.00772***
	(0.015)	(0.011)	(0.0033)	(0.00076)
$75,000 and above	0.214***	-0.151***	-0.0513***	-0.0113***
	(0.015)	(0.012)	(0.0034)	(0.00091)
Household size = 2	-0.00247	0.00161	0.000685	0.000168
	(0.012)	(0.0076)	(0.0032)	(0.00080)
Household size = 3	-0.00611	0.00399	0.00170	0.000420
	(0.014)	(0.0093)	(0.0040)	(0.00099)
Household size = 4+	-0.0228	0.0148	0.00635	0.00157
	(0.014)	(0.0094)	(0.0041)	(0.0010)
Married	-0.0137	0.00899	0.00380	0.000928
	(0.010)	(0.0066)	(0.0028)	(0.00069)
Current smoker	-0.178***	0.102***	0.0590***	0.0177***
	(0.010)	(0.0052)	(0.0043)	(0.0017)
Former smoker	-0.102***	0.0636***	0.0303***	0.00802***
	(0.0094)	(0.0057)	(0.0030)	(0.00094)
Year 1997	-0.0143	0.00929	0.00403	0.00100
	(0.013)	(0.0082)	(0.0036)	(0.00092)
Year 1999	-0.0114	0.00743	0.00321	0.000795
	(0.013)	(0.0083)	(0.0036)	(0.00091)
Year 2000	-0.000299	0.000196	0.0000830	0.0000203
	(0.013)	(0.0087)	(0.0037)	(0.00090)
Year 2002	0.0124	-0.00816	-0.00339	-0.000821
	(0.013)	(0.0084)	(0.0034)	(0.00082)
Year 2004	0.0159	-0.0105	-0.00436	-0.00105
	(0.013)	(0.0086)	(0.0035)	(0.00083)
Year 2006	0.0302	-0.0202	-0.00814	-0.00194*
	(0.019)	(0.013)	(0.0050)	(0.0012)
Observations	27,693	27,693	27,693	27693

*** p<0.01, ** p<0.05, * p<0.1

Reference categories (omitted from table): male, age 18-24, white, less than high school education, annual income less than $10,000, household size of one, not married, never smoked, Year 1995. California Behavorial Risk Factor Survey years included were: 1995, 1997, 1999, 2000, 2002, 2004, and 2006.

TABLE 3

The Overall Probability of Missing Teeth Due to Disease

Select subgroups		Probability of missing 1-5 teeth	Probability of missing 6+ (not all) teeth
		[95% confidence interval]	[95% confidence interval]
Subgroup (1):	Male, aged 45-54, white, post-college education, never smoked family income $75,000 or greater, married, household of 4 or more, 2006	0.2018 [0.2003, 0.2033]	0.0182 [0.0180, 0.0185]
Subgroup (2):	Female, aged 25-34, black, high school education, current smoker	0.4499 [0.4427, 0.4571]	0.1219 [0.1189, 0.1248]
Subgroup (3):	Male, aged 35-44, Hispanic, less than high school education, current smoker family income $15,000 - $19,999, married, family of 4 or more, 2006	0.4711 [0.4626, 0.4796]	0.1531 [0.1491, 0.1571]
Subgroup (4):	Female, aged 65-74, Asian/Pacific Islander, some college, never smoked, family income $50,000 - $74,999, unmarried, lives alone, 2006	0.4083 [0.3960, 0.4205]	0.3000 [0.2884, 0.3116]

Source: Petris Center analysis of data from the 1995-2006 California Behavioral Risk Factor Surveillance Survey.

The first subgroup has a low probability of missing teeth due to disease, having only a 20.2 percent probability of missing one to five teeth and a 1.8 percent probability of missing six or more teeth (but not all). The second subgroup has a drastically higher probability of missing any teeth due to disease, having a 45.0 percent probability of missing one to five teeth and a 12.2 percent probability of missing six or more teeth (but not all).

The third subgroup also has a high probability of missing teeth due to disease, having a 47.1 percent probability of missing one to five teeth and a 15.3 percent probability of missing six or more teeth (but not all). The final subgroup also has a high probability of missing teeth due to disease, having a 40.8 percent probability of missing one to five teeth and a 30.0 percent probability of missing six or more teeth (but not all).

Discussion

These findings identified the adult characteristics and subgroups at the greatest risk for tooth loss and possible edentulism. As expected, risk of tooth loss due to disease increased with age in the pooled model. Racial/ethnic minorities were also at higher risk for tooth loss, and a social gradient pattern of tooth loss was evident by income and education levels. Each incremental increase in education and in annual household income beyond the $25,000-$24,999 bracket yielded a lower probability of missing teeth. Higher levels of educational attainment and income were protective factors. These trends were similar to other findings in the literature that show an inverse relationship between socioeconomic status and oral health status.[20-23]

Watt suggested addressing the social determinants of oral health inequalities through focusing efforts on "upstream action" and rethinking the approach to preventive efforts.[24] Currently, dental practices are more oriented to providing curative treatment. Many dental providers offer some clinical preventive measures and dental education during visits, but these are "downstream" efforts that are not as effective in preventing future problems. Preventive action at the community and state levels around oral health promotion is needed if California aims to dramatically reduce oral health disparities.

Results also indicated an increased risk of tooth loss among current smokers, compared to nonsmokers. Former smokers were also at higher risk of tooth loss than nonsmokers, but the probability of loss was not as high as for current smokers. The negative impact of tobacco use on tooth retention has been previously documented, but there is an emerging literature estimating that former smokers' risk levels can be reduced to that of nonsmokers after about 10 years or more of refraining from smoking.[15-17,25]

The possibility of such dramatic risk reduction has implications for clinical practice; dental providers could include more smoking cessation counseling and support as part of their oral health promotion/education messages during routine visits. Current smokers could be targeted for these messages and referred to cessation programs, but it will also be important to offer encouragement and possibly refer former smokers to resources that will help them refrain from relapsing over time since the tooth loss risk reduction appears greatest after several years of no longer smoking.[25]

California is already a policy leader in the area of smoke-free laws, and smoking prevalence has decreased in the last few decades as a result.[26] In 2006, the smoking rate among all California adults was 14.9 percent, and among adult smokers aged 18-35, 54.8 percent had quit for more than one day.[27] Past

studies have explored whether dentists advised smokers to quit, and found that in the early 1990s, most did very little for their patients in this area.[28,29]

More recently, some pilot studies aiming to improve dental practices' ability to address tobacco use have shown success.[30,31] For instance, two two-hour dental clinic staff trainings helped improve staff knowledge about the importance of discussing smoking status with patients and led to higher rates of staff awareness and use of the "Five A's" of tobacco cessation (ask, advise, assess, assist, and arrange follow-up).[30]

Some evidence suggests that if a dental office can offer brief counsel and also refer a patient to a tobacco quitline, those referred to the quitline who complete all the telephone consultations had higher rates of abstaining from smoking.[31] These pilot projects suggest promising directions for supporting dental providers' efforts in providing patients with smoking cessation counseling and referrals.

Some studies suggested that smokers are less likely than nonsmokers to regularly visit the dentist, so it is possible there may be fewer opportunities for dental providers to offer smoking counseling or referrals to current smokers.[32] However, dentists and hygienists should use dental visits as an opportunity to communicate the oral health risks of tobacco use to all their patients as well as promote good oral hygiene practices.

Regular dental visits are necessary to help prevent disease, treat problems early before tooth loss occurs, and promote optimal oral health throughout the lifespan. Tooth loss due to disease is an avoidable experience. Yet, fear of the dentist is fairly prevalent, and, in 1995, it was the third most common reason given by California adults for not going to the dentist (reported by 9.2 percent).[33]

Additionally, many adults, especially those from lower socioeconomic backgrounds, encounter substantial barriers (such as lack of insurance, financial resources, transportation) to regular access to dental care.[33,34] Even those with Medi-Cal coverage have experienced problems accessing needed dental care. A typical issue with many Medicaid programs is a lack of providers.[35]

Another recently identified problem in California is that a significant portion of adults on Medi-Cal do not realize they also have Denti-Cal.[36] However, Medicaid access issues are no longer the greatest concern. Federal law does not require states to offer adult dental benefits under Medicaid, and this coverage can be eliminated. Although adult dental is one of the most commonly offered optional Medicaid benefits, during budget crises, many states put it on the chopping block. California cut most adult Medicaid dental benefits beginning July 1, 2009.[37]

FEDERAL LAW does not require states to offer adult dental benefits under Medicaid, and this coverage can be eliminated.

Some of the only dental services that will be available to the adult Medicaid population will include tooth removal for the relief of pain and infection, while virtually all preventive and restorative services will no longer be covered.[38] This policy change puts many adults already at the greatest risk for losing teeth due to disease at an even higher risk for this outcome. California needs to promote the enactment of programs and policies that will enhance rather than reduce access to routine comprehensive dental care for all adults, particularly its most vulnerable, in the future.

There were some limitations to the present study to note. First was the lack of dental insurance as a variable in the model. While it is commendable that California has included the optional oral health module in its BRFS data collection often, not all years contain information on dental insurance. Unfortunately, the dental insurance question was only included in the 1995, 1997, and 2000 BRFS, but not in the more recent years oral health data was collected, thus limiting the ability to examine the relationship between dental insurance and adult tooth loss. All BRFS data was self-reported and answers may be subject to recall and social desirability biases.

Conclusion

A significant proportion (almost 40 percent) of California adults suffered the loss of one or more teeth due to disease in 2006. In the 11-year (1995-2006) pooled multivariate analysis, Californians who are older, less educated, racial/ethnic minorities, have lower annual household incomes, and are current or former smokers are more likely to be part of this group. As the population ages, it will become increasingly more important to understand the trends and work to prevent tooth loss among adults in California. ■■■■

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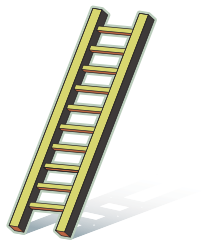

The Oral Health Status of Adults 65 and Older in California: 1995-2006

TIMOTHY T. BROWN, PHD, AND YEVGENIY GORYAKIN, PHD

ABSTRACT There has been no overall change in the oral health of adults aged 65 years and older from 1995 to 2006. However, approximately 75 percent of the elderly in California were missing one or more teeth due to disease in 2006. Californians who are older, black, less educated, have low family income, and are current or former smokers are more likely to be missing teeth.

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Individuals aged 65 and older are particularly susceptible to oral health problems, which tend to increase with age. Oral health is particularly important for the elderly. Oral health problems that cause difficulty with chewing and eating can interfere with nutrition. Individuals who are missing teeth or who are edentulous may limit the types of food they eat to soft foods, potentially limiting the nutritional content of their food. This can contribute to both poor nutritional status and to unintended weight loss.[1,2] In addition, diets with low intakes of vitamin D and calcium can contribute to further tooth loss.[3]

In addition, one's oral health status can affect and be affected by other health problems. An increasing area of research focuses on how periodontal diseases interact and are associated with other common conditions through various inflammatory processes. Periodontal disease has been shown to be associated with many diseases that affect the elderly including heart disease, stroke, osteoporosis, pneumonia, and diabetes.[4-14]

Preventive dental care is as important, if not more so, for the elderly as it is for younger age groups. The long-term incidence of periodontal attachment loss has been found to be common among the elderly suggesting that periodontal treatment continues to be important.[15] Even those who are edentulous benefit from preventive care. Approximately 30,000 new cases of oral cancer are reported annually, with 50 percent occurring in those aged 65 and older. The progression of bone resorption, poor nutrition, and oral health problems that affect social interactions can all be avoided through periodic assessments that allow needed interventions to be done in a timely manner.[16]

The population of those aged 65 years or older to which all of the above applies is growing in California. It is expected to increase by 112 percent from 1990 to 2020 according to the California Department of Aging.[17] While there has been an improvement nationally in the number of teeth

maintained by adults as they age, not all elderly share in this improvement.[18,19] A number of factors have been found to be associated with tooth loss. A more advanced age, lower levels of education, lower incomes, and being black have all been found to be associated with edentulism in research based on national survey data.[20]

To date there has been no long-term analysis of the oral health of the elderly population in California. In order for private and public stakeholders to perform appropriate planning that ensures that sufficient resources are devoted to caring for the oral health of California's elderly population, it is critical to clearly measure both overall oral health among the elderly and the variation in oral health across subgroups.

While the most precise way to determine the oral health status of the elderly population is through clinical evaluation conducted by licensed dentists, this approach is prohibitively expensive when surveying large population groups.[21] An alternative approach is to use a simple measure of oral health that can be accurately determined via telephone surveys and which provides a good approximate picture of the oral health of a population. This measure is the self-reported number of teeth that an adult is missing due to disease.

A study by Lang et al. compared the measure of teeth missing due to disease with the Oral Health Status Index, OHSI, an index that combines information from a clinical examination of the teeth and the periodontium into an overall score ranging from -54 to 100.[6] The OHSI was developed by Marcus et al. and validated in both general and minority populations.[22,23] Lang et al. found that the measure of missing teeth, a component of the OHSI, performed almost as well as the OHSI in a population aged 18 to 93.[24] Since the elderly are far more likely to be missing teeth due to poor oral health status than younger individuals, this is a good measure for our purposes. Self-reported information on missing teeth collected in telephone interviews has been validated in both middle-aged adults and the elderly.[25,26]

In this paper, the authors use the measure of teeth missing due to disease to examine the oral health of the elderly population of California using data from 1995 to 2006. The authors explore the association between oral health and basic sociodemographic characteristics of elderly individuals.

A MORE ADVANCED AGE, lower levels of education, lower incomes, and being black have all been found to be associated with edentulism in research based on national survey data.

Methods

This analysis uses the 1995, 1997, 1999, 2000, 2002, 2004, and 2006 versions of the California Behavioral Risk Factor Survey, BRFS. (Although the BRFS is an annual survey, not all years of the BRFS contained questions on missing teeth. Approximately every other year contained information on missing teeth.) The Behavioral Risk Factor Survey is an ongoing collaborative effort of the California Department of Health Services, the Public Health Institute, and the Centers for Disease Control and Prevention. The survey is conducted by the Survey Research Group, SRG, of the California Department of Health Services, CDHS, Cancer Surveillance Section, CSS. It is supported in part by funds from Cooperative Agreement No. U58/CCU922811-03 from the Centers for Disease Control and Prevention, U.S. Public Health Service, and in part by funds from the programs who add questions to the survey.

Data were collected from adults aged 18 and over through a random digit-dial telephone survey. The 2006 California BRFS sample size is 5,692 individuals. Earlier surveys contained approximately 4,000 to 4,500 observations per year. However, since the authors are only considering individuals aged 65 and older, the estimation sample across all years only contains 4,659 observations, in keeping with the fact that only approximately 11 percent of California's population is aged 65 or older.[27] The BRFS survey question asked "How many of your permanent teeth have been removed because of tooth decay or gum disease? Include teeth lost to infection, but do not include teeth lost for other reasons, such as injury or orthodontics," and added the following note,"If wisdom teeth are removed because of tooth decay or gum disease, they should be included in the count for lost teeth."

The data used allow for four levels of oral health with regard to missing teeth: (1) no missing teeth, (2) one to five missing teeth, (3) missing six teeth or more, but not all, and (4) all teeth missing (edentulism). In order to correctly assess long-term changes in oral health over the 1995-2006 period, it is essential to account for the changes that have occurred in the characteristics of the elderly population of California during this time. For example, the oral health of the elderly population may appear to be worsening over time if the elderly population as a whole is simply getting older on average as time passes. Conversely, the oral health of the elderly population may appear to be

improving over time when in fact the population as whole is simply becoming younger on average as time passes (e.g., the oldest elderly Californians move to other states and/or the younger elderly move to California from other states).

This can be accounted for by statistically removing the effects of the changing age composition of the elderly population. In order to accurately measure long-run trends, the authors not only removed the effects of changes in the age composition of the elderly population, but also account for other changes in the composition of the population that may change over time.

The authors thus accounted for the following sociodemographic factors: gender (male, female), age (65-69, 70-74, 75-79, 80-84, and 85 or greater), marital status (unmarried, married), education status (less than high school, high school graduate, some post-high school training, college graduate, post-college), and race/ethnicity (white, Asian/Pacific Islander, Hispanic, black, and other race), annual household income (less than $10,000; $10,000-$14,999; $15,000-$19,999; $20,000-$24,999; $25,000-$34,999; $35,000-$49,999; $50,000-$74,999; $75,000 or higher), household size (1, 2, 3, 4 or more), and smoking status (never smoked, former smoker, current smoker).

All regressions are estimated using ordered probit. Ordered probit is similar to ordinary probit but allows simultaneous estimation of outcomes that are categorically ordered. The statistical software used was Stata 9.2. The authors do not report the actual ordered probit coefficients or cut-points as they are not interpretable without transformation. The coefficients reported in each table are transformed and scaled so that they represent marginal probabilities, on a scale from 0 to 1 (so a coefficient of, for example, 0.05, implies a five percent probability that a person is included in the category of missing teeth being examined relative to the reference group).

Marginal probabilities are computed assuming that all other independent variables are equal to their means (the average person in the population). The statistical analysis accounts for the survey design of the BRFS including probability weighting. Probability weights were standardized to the population of California according to the 2000 U.S. Census using weights supplied by the Survey Research Group.

TABLE 1

Weighted Sample Proportions, Adults Aged 65 and Older: 1995-2006

Variables	Weighted Sample Proportions
GENDER	
Male	44.3%
Female	55.8%
Age	
65-69	32.8%
70-74	27.3%
75-79	22.2%
80-84	12.1%
85 and older	5.6%
RACE/ETHNICITY	
White	70.6%
Black	5.0%
Asian/Pacific Islander	9.5%
Hispanic	12.6%
Other	2.3%
EDUCATION	
Less than high school	15.9%
High school	27.5%
Some post-high school	27.7%
College graduate	17.3%
Post college	11.6%
HOUSEHOLD SIZE	
1 person	31.2%
2 people	54.0%
3 people	8.0%
4 or more people	6.8%
FAMILY INCOME	
Less than $10,000	12.2%
$10,000-$14,999	11.6%
$15,000-$19,999	10.6%
$20,000-$24,999	10.8%
$25,000-$34,999	15.0%
$35,000-$49,999	15.7%
$50,000-$74,999	12.4%
$75,000 or higher	11.7%
MARITAL STATUS	
Married	54.9%
Unmarried	45.1%
Smoking	
Current	7.5%
Former	46.3%
TEETH MISSING	
None	15.1%
1 to 5	37.2%
6 or more (but not all)	25.0%
All	22.7%
Observations	4,659

Results

During 2006 in California, 74.6 percent of the elderly suffered from reduced oral health status, that is, they were missing one or more teeth due to disease. Among the elderly, 14.3 percent were edentulous, suffering the loss of all teeth. Another 26.9 percent suffered from the loss of six or more, but not all, teeth. Finally, 33.3 percent suffered from the loss of one to five teeth. (The sum of the three subsets does not exactly equal 74.6 due to rounding.) Descriptive statistics for all data from 1995 to 2006 are shown in **TABLE 1**.

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TABLE 2

The Association of Individual Characteristics and Missing Teeth in California Adults Aged 65 and Older: 1995-2006

Variables	(1) No Teeth Missing	Std. Errors	(2) 1 to 5 Teeth Missing	Std. Errors	(3) 6 or More Teeth Missing (but not all)	Std. Errors	(4) All Teeth Missing	Std. Errors
GENDER								
Male	reference		reference		reference		reference	
Female	-0.012	0.014	-0.004	-0.004	0.007	0.009	0.009	0.010
Age								
65-70								
70-74	0.001	0.016	0.000	0.006	-0.001	0.010	-0.001	0.012
75-79	-0.013	0.017	-0.005	0.007	0.008	0.011	0.010	0.013
80-84	-0.044***	0.017	-0.020**	0.009	0.028***	0.010	0.037**	0.015
85 and older	-0.053**	0.022	-0.026*	0.014	0.033**	0.013	0.047**	0.022
RACE/ETHNICITY								
White								
Black	-0.082***	0.021	-0.048***	0.018	0.050***	0.012	0.080***	0.027
Asian/Pacific Islander	-0.041	0.028	-0.018	0.016	0.025	0.017	0.034	0.026
Hispanic	0.123***	0.030	0.019***	0.004	-0.074***	0.017	-0.068***	0.012
Other race	-0.081	0.052	-0.049	0.048	0.049	0.029	0.080	0.071
EDUCATION								
Less than high school								
High school	0.033	0.023	0.011	0.007	-0.020	0.014	-0.023	0.015
Some college	0.095***	0.024	0.024***	0.005	-0.058***	0.015	-0.061***	0.014
College graduate	0.110***	0.030	0.021***	0.004	-0.067***	0.018	-0.065***	0.014
Post-college	0.155***	0.035	0.017***	0.005	-0.092***	0.020	-0.080***	0.013
INCOME								
Less than $10,000								
$10,000-$14,999	-0.036	0.026	-0.016	0.013	0.022	0.016	0.029	0.023
$15,000-$19,999	0.068**	0.030	0.016***	0.004	-0.042**	0.018	-0.042***	0.016
$20,000-$24,999	0.073**	0.031	0.016***	0.004	-0.045**	0.019	-0.045***	0.016
$25,000-$34,999	0.111***	0.032	0.020***	0.003	-0.067***	0.019	-0.064***	0.015
$35,000-$49,999	0.140***	0.033	0.021***	0.004	-0.084***	0.019	-0.077***	0.014
$50,000-$74,999	0.237***	0.037	0.004	0.010	-0.134***	0.019	-0.107***	0.011
$75,000 or higher	0.250***	0.043	-0.001	0.013	-0.140***	0.021	-0.109***	0.012
HOUSEHOLD SIZE								
1 person								
2 people	-0.013	0.020	-0.005	0.007	0.008	0.012	0.009	0.015
3 people	-0.038	0.030	-0.017	0.016	0.024	0.018	0.031	0.028
4 or more people	-0.050	0.032	-0.024	0.020	0.031	0.019	0.043	0.033

TABLE 2 CONTINUES ON 575

TABLE 2 CONTINUED FROM 574

MARITAL STATUS								
Unmarried								
Married	-0.001	0.020	0.000	0.007	0.000	0.013	0.000	0.015
SMOKE								
Never smoked								
Current	-0.149***	0.012	-0.124***	0.019	0.079***	0.006	0.194***	0.027
Former	-0.101***	0.013	-0.038***	0.006	0.062***	0.008	0.076***	0.010
YEAR								
1995								
1997	0.017	0.020	0.006	0.006	-0.011	0.013	-0.012	0.014
1999	-0.028	0.020	-0.012	0.009	0.017	0.012	0.022	0.017
2000	-0.018	0.022	-0.007	0.010	0.011	0.014	0.014	0.018
2002	-0.011	0.020	-0.004	0.008	0.007	0.012	0.008	0.015
2004	0.010	0.021	0.003	0.007	-0.006	0.013	-0.007	0.014
2006	-0.011	0.027	-0.004	0.011	0.007	0.017	0.008	0.021
Observations: 4,659 *p≤0.05, **p≤0.01, ***p≤0.001								

Marginal effects from ordered probit model. Actual coefficients and cut-points not reported.

Over the 11-year period of 1995 to 2006, it was found that there has been no detectable change in the overall oral health status of the elderly population of California. **TABLE 2** shows that none of the year indicators are statistically different from zero, indicating there has been no change in the oral health status of the elderly population, as measured by missing teeth due to disease from 1995 to 2006.

TABLE 2 also presents the probabilities that elderly individuals in California with different characteristics will have differing numbers of teeth missing due to disease. Each entry in the table should be understood as the change in probability that a person with a given characteristic will have a given number of missing teeth relative to the reference group where all other variables in the sample are at their means. The reference group is listed for each group of variables.

In column 1 of **TABLE 2**, the numbers refer to the probability of a person having lost none of their teeth to disease. In column 2 of **TABLE 2**, the numbers refer to the probability of a person having lost one to five teeth due to disease. In column 3 of **TABLE 2**, the numbers refer to the probability of a person having lost six or more teeth (but not all). Finally, the numbers in column 4 of **TABLE 2** refer to the probability of a person has lost all of their teeth to disease. The authors' focus on columns 2 and 3 since these columns represent the bulk of elderly Californians with poor oral health. These columns also represent elderly Californians who still have teeth that can be saved.

In column 2 of **TABLE 2**, it can be found that age is related to whether a person has lost one to five teeth due to disease. Those aged 70 to 79 are not more likely, those aged 80 to 84 are 2.0 percentage points less likely, and those aged 85 years and older are 2.6 percentage points less likely than those aged 64 to 69 to have lost one to five teeth due to disease.

In column 3 of **TABLE 2**, it also can be found that the older a person is, the more likely they are to have lost six or more teeth (but not all) due to disease. While those aged 70 to 79 are not more or less likely, those aged 80 to 84 are 2.8 percentage points more likely, and those aged 85 and older are 3.3 percentage points more likely than those aged 64 to 69 to have lost six or more teeth (but not all) due to disease.

Also found were that some racial/ethnic groups differ a great deal from whites with regard to the likelihood that they are missing teeth. Column 2 of **TABLE 2** shows that blacks are 4.8 percentages points less likely, and that Hispanics are 1.9 percentage points more likely than whites to be missing one to five teeth. In column 3 of **TABLE 2** we see that blacks are 5.0 percentages points more likely, and that Hispanics are 7.4 percentage points less likely than whites to be missing six or more (but not all) teeth.

Education is also associated with tooth loss due to disease. In column 2 of **TABLE 2**, those who are have attended some post-high school training are 2.4 percentage points more likely, those who have graduated from college are 2.1 percentage points more likely, and those who have post-college education are 1.7 percentage points more likely to have lost one to five teeth due to disease relative to those with

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TABLE 3

The Overall Probability of Missing 1 to 5 Teeth Due to Disease in 2006

Select Subgroups		Probability	95% CI (lower)	95% CI (upper)
Subgroup (1):	Year 2006, male, aged 65-69, white, college graduate, never smoked, household income of $75,000 or greater, married, household of four or more	0.391	0.375	0.408
Subgroup (2):	Year 2006, female, aged 65-69, black, high school education, current smoker, household income of $35,000-$49,999, unmarried, household of four or more	0.180	0.162	0.198
Subgroup (3):	Year 2006, male, aged 80-84, Hispanic, less than high school education, current smoker, household income of $35,000-$49,999, married, household of four or more	0.319	0.295	0.343
Subgroup (4):	Year 2006, female, aged 65-69, Asian/Pacific Islander, some college education, former smoker, household income of $20,000-$24,999, married, household of four or more	0.326	0.302	0.350

less than high school education. In column 3 of TABLE 2, those who attended some post-high school training are 5.8 percentage points less likely, those who have graduated from college are 6.7 percentage points less likely, and those who have post-college education are 9.2 percentage points less likely to have lost six or more (but not all) teeth due to disease relative to those with less than high school education.

Household income is also related to the loss of teeth due to disease (note that household income is adjusted for household size by the inclusion of household size in the model). In column 2 of TABLE 2, those individuals with a household income that is $15,000-$19,999 are 1.6 percentage points more likely, those with a household income that is $20,000-$24,999 are 1.6 percentage points more likely, those with a household income that is $25,000-$34,999 are 2.0 percentage points more likely, and those with a household income that is $35,000-$49,999 are 2.1 percentage points more likely than those with a household income that is less than $10,000 to missing one to five teeth.

In column 3 of TABLE 2, it can be seen that those individuals with a household income that is $15,000-$19,999 are 4.2 percentage points less likely, those with a household income that is $20,000-$24,999 are 4.5 percentage points less likely, those with a household income that is $25,000-$34,999 are 6.7 percentage points less likely, those with a household income that is $35,000-$49,999 are 8.4 percentage points less likely, those with a household income that is $50,000-$74,999 are 13.4 percentage points less likely, and those with a household income that is $75,000 or higher are 14.0 percentage points less likely than those with a household income that is less than $10,000 to have lost six or more teeth (but not all).

Finally, smoking is associated with the loss of teeth due to disease. In column 2 of TABLE 2, current smokers are 12.4 percentage points less likely, while former smokers are 3.8 percentage points less likely than those who have never smoked to have lost one to five teeth. In column 3 of TABLE 2, current smokers are 7.9 percentage points more likely, while former smokers are also 6.2 percentage points more likely than those who have never smoked to have lost six or more teeth (but not all).

To get an understanding of how oral health status varies across different socioeconomic groups, four subgroups of individuals are examined. These subgroups are for purposes of illustration only and were chosen to show the diversity in the likelihood of missing teeth across different groups.

The first subgroup is made up of white males, aged 65-69, who are college graduates, have a household income equal to $75,000 or more, have never smoked, are married, and have a household of four or more people. The second subgroup is made up of black females, aged 65-69, who have a high school education, have a household income that is $35,000-$49,999, are current smokers, are unmarried, and have a household of four or more people. The third subgroup is made up of Hispanic males, aged 80-84, who have less than a high school education, have a family income that is $35,000-$49,999, are current smokers, are married, and have a household of four or more people. The final subgroup is made up of Asian females, aged 65-69, who have some college education, have a household income that is $20,000-$24,999, are former smokers, are married, and have a household of four or more people.

As can be seen in TABLES 3 AND 4, these subgroups vary a great deal in the overall probability that they will fall into a given category with regard to missing teeth. The first subgroup has a 0.391 probability of missing one to five teeth and a 0.145 probability of missing six or more teeth (but not all). The second subgroup has an 0.180 probability of missing one to five teeth and a 0.316 probability of missing six or more teeth (but not all).

TABLE 4

The Overall Probability of Missing 6 or More Teeth (but Not All) Due to Disease In 2006

Select Subgroups		Probability	95% CI (lower)	95% CI (upper)
Subgroup (1):	Year 2006, male, aged 65-69, white, college graduate, never smoked household income of $75,000 or greater, married, household of four or more	0.145	0.140	0.150
Subgroup (2):	Year 2006, female, aged 65-69, black, high school education, current smoker, household income of $35,000-$49,999, unmarried, household of four or more	0.316	0.291	0.341
Subgroup (3):	Year 2006, male, aged 80-84, Hispanic, less than high school education, current smoker, household income of $35,000-$49,999, married, household of four or more	0.331	0.310	0.351
Subgroup (4):	Year 2006, female, aged 65-69, Asian/Pacific Islander, some college education, former smoker, household income of $20,000-$24,999, married, household of four or more	0.328	0.308	0.348

The third subgroup has 0.319 probability of missing one to five teeth and a 0.331 probability of missing six or more teeth (but not all). The final subgroup also has a high probability of missing teeth due to disease, having a 0.326 probability of missing one to five teeth and a 0.328 probability of missing six or more teeth (but not all).

Discussion

The variation among subgroups of adults aged 65 and older suggest areas where significant progress is possible in terms of both prevention and restorative care. Targeted interventions may be able to effectively reduce the current disparities that exist between each group.

Interventions focused on smoking cessation may yield the largest gains. Interventions in the area of smoking cessation have been extensively studied and their effectiveness is well understood.[28,29]

An additional potential area of intervention is dental insurance, particularly among the Medi-Cal population. Among men aged 65 and older, those who are enrolled in Medi-Cal and also know they are covered by Denti-Cal are just as likely to visit a dental provider as those with private dental insurance, while those with Medi-Cal who don't know they are also covered by Denti-Cal are no more likely to visit a dental provider than the uninsured.[30] Education about Denti-Cal would likely resolve this problem. Although most Denti-Cal benefits will not be available to adults starting July 1, 2009, this does not mean that Denti-Cal benefits will never be restored. Policy opportunities vary over time depending on the political and economic environment and the above policy intervention may be viable over the long run.

Finally, improving access to care among those with functional limitations also has significant potential to improve the oral health of individuals who have mobility problems. This has been extensively discussed elsewhere in this issue.[30]

This study is subject to a number of limitations. First, dental insurance is missing from the authors' model. Data on dental insurance was only available for the years 1995, 1997, and 2000 and therefore could not be included in the long-term analysis. In addition, the authors' data is made up of repeated cross-sections which did not allow for control for unmeasured individuals differences that do not change over time and the authors' results may therefore be subject to omitted variable bias.

Conclusion

Almost three-quarters of California adults aged 65 and older have diminished oral health. The 11-year (1995-2006) analysis showed that Californians who are older; black; less educated; have low household incomes, and are current or former smokers are more likely to be missing teeth. A focused approach on reducing the variation in oral health that exists in this population may yield large gains on the average level of oral health. ■■■■

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Economizing

Accumulation of ten (10) demerits for restroom violations will be cause for termination.

Robert E. Horseman, DDS

ILLUSTRATION BY CHARLIE O. HAYWARD

In this perilous time of worldwide economic tribulation, it is becoming increasingly clear that it is easy to economize if you are broke. When you put this seriously into practice what you do is buy the giant 5-pound jar of peanut butter at Costco, then buy the smallest economy car that will accommodate two clowns and gets 50 miles per gallon of reconstituted methane. It's the American way of watching the government running in the red and concluding the economic state of the nation must be rosy.

Dentistry's worst nightmare currently is that some mid-Eastern cartel will corner the market on the world's supply of porcelain, driving us ever closer to needing a multimillion-dollar bailout from the American Dental Association. Rather than sit by idly worrying if the same thing could happen to titanium, our office is immediately instituting measures to become more cost effective.

The following memo has been circulated amongst our two employees:

■ We have signed with a selected group of PPO organizations who have generously volunteered to maintain a strict adherence to a new downsized fee schedule by refusing to pay more than a table of allowances as determined by their skilled and highly remunerated executives.

■ The cost of disposable items has become disproportionate to the convenience thereof. Effective immediately, their use will be sharply curtailed as follows:

A. At the start of business on Monday each week one (1) pair of latex gloves shall be issued to each employee. It will be your responsibility to maintain the gloves' integrity until the next weekly issue. When any given procedure does not require the use of both hands, a single glove shall be worn on the appropriate hand. Gloves shall be washed between patients using a generic Costco material obtained from the 50-gallon drum in the lab. They are to be waved about vigorously in open sunlight to render them semi-sterile. Careless glove maintenance requiring the use of duct tape will be penalized according to the demerit schedule issued previously.

B. Facial tissues and patient bibs account for 36 percent of the office supply

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budget. Henceforth, female patients shall be instructed to remove lipstick or gloss before leaving home. Male patients should use their ties if available, otherwise continue to wipe their mouths with the backs of their hands as before. Both sexes shall be instructed in the technique of rinsing to minimize bib slobbering when under the influence of a mandibular block.

C. Proprietary mouthwashes shall be available at a nominal extra cost. Tap water will be provided at no cost other than 18 cents per plastic cup.

D. Patient bibs shall be recycled at the end of business each day. Assistants with the rank of RDA and below shall hose down used bibs in the parking lot and hang them up about the operatories overnight to dry.

E. Stone models shall be recycled by beating them repeated with a blunt object such as your shoe until reduced to pieces no larger than 2 mm on a side. Placed in a blender or Cuisinart for 2.5 minutes, they should be reduced to powder for reuse.

F. Current impression and filling materials are no longer cost effective under the management's new fee schedule. The present cost of $65 for 5 ml of bonding material has been reduced by purchasing it in 10-gallon lots from a Tijuana outlet at a savings of $56,000. Surplus stocks of silicate cement and red base plate wax, both of which worked well in the past, will be reintroduced.

■ The telephone company has installed a voice recognition module. When it recognizes one of your family or friends on an incoming call, a recorded message announces "This number is no longer in service. The party with whom you wish to speak can be reached via Western Union or the U.S. Postal Service."

■ A recent study by the Bureau of Human Resources has confirmed that employees are abusing their restroom privileges. This has resulted in the following changes to our Restroom Policy:

A. Upon the completion of the restroom refitting, an ATM card shall be required for admission to the facilities. Your card will activate a timer preset for five (5) minutes, an interval management deems generous enough for the completion of your business there.

B. In the event of further dalliance, the toilet will flush automatically, the stall door will fly open, other amenities will be rendered inoperable and the surveillance camera will take your picture. Accumulation of ten (10) demerits for restroom violations will be cause for termination.

■ The installation of vending machines in the reception area is now completed. Service will be provided by Ptomaine Tommy's Fawlty Foods, Inc., low contract bidder. While not mandatory, use of the machines enables you to take advantage of the 15-minute lunch break.

■ Medical benefits continue as before with minor modifications. Johnson & Johnson is the new carrier. Benefits will be confined to those that can be treated in-house with the carrier's products, not to exceed four (4) Band-Aids in any one quarter.

■ The previous policy of five (5) paid public holidays per year has resulted in dissension when one or more of them fell on a Sunday. The new Holiday Policy has been consolidated into a fairer and more easily regulated one. Christmas, New Year's Day, 4th of July, Memorial Day and G.V. Black's birthday have been replaced by Leap Year's Day. February 29th will be observed henceforth even if it falls on a weekend.

The management appreciates your cooperation in following the above guidelines to accomplish our mutual goal of doing more for less. Please initial this memo with one hand on the Bible. Choice of hands is optional. ■■■■

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