

Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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Dental Hygiene Research: Not Just for Educators

Danielle F Furgeson, RDH, MS

Danielle Furgeson graduated with a Master of Science degree in Dental Hygiene Education from the University of North Carolina School of Dentistry in May 2007. Her thesis project entitled, "The Role of the Student Professional Association in Mentoring Dental Hygiene Students for the Future," is published in this issue of the Journal of Dental Hygiene. Danielle's research was awarded special recognition in the 2007 Sigma Phi Alpha Journalism Award Competition. She is currently the manager of student relations at the American Dental Hygienists' Association and can be reached at DanieF@adha.net.

Research is a word that conjures up different ideas for different people. Some think of the mad scientist type in a laboratory full of bubbling beakers and test tubes. Others may envision a professor behind a desk, barricaded by stacks of dusty tomes. For some dental hygienists, it is their life passion, while others may think that there is no way they could possibly do research. One thing is for certain, now more than ever, the profession of dental hygiene needs researchers to take a lead.

If you are wondering why, the answer is quite simple. The rules of engagement for health care providers have changed dramatically, with no sign of slowing down any time soon. Arguably, the most profound change in health care administration has to be the recognition of the importance of evidence-based practice. From physical therapy to nursing, professions as a whole have embraced evidence-based practice and have looked to the grassroots-level provider (such as the practicing dental hygienist) to expand their databases. For example, the American Physical Therapy Association has a program called "*Hooked on Evidence*" available to its members that allows them to access, contribute, and put into practice evidence-based knowledge relevant to the practice of physical therapy.¹ They do this because they understand that patients need and deserve the most current, tried-and-true treatments available. There is simply no other way to administer this sort of care other than understanding the importance of and being able to access the body of evidence-based knowledge.

Where does dental hygiene fit into this paradigm? Health care today is moving towards a more preventive model, which puts the dental hygienist in a prime position. As dental hygiene professionals, we are by nature preventive health care providers. Our patients have expectations, many unspoken, that the dental hygienist is giving them the most current, sound treatment and information. Nobody knows what you do better than you, and more importantly, nobody knows what information a dental hygienist needs most than a dental hygienist! Other professions, such as nursing and pharmacy, have recognized this and have embraced the idea that it is their responsibility to document the value of their services and contribute to the body of knowledge, and not wait for those outside of their profession to do it for them.² If we are the preventive arm of the dental profession, then we as dental hygienists should be *the* source, if not a major contributor to the body of evidence-based preventive dental medicine. In 2005, a report was released by the American Dental Hygienists' Association entitled "Dental Hygiene: Focus on Advancing the Profession," which called for an increase in the number of dental hygienists contributing to the dental hygiene body of knowledge, with the goal of meeting national health objectives and encouraging the propagation of integrative and systematic literature reviews as well as meta-analyses.³

Contributing to the dental hygiene body of knowledge can be very rewarding. One route to learning how to contribute to the knowledge base is by going to graduate school like I did in 2005. If this is simply not an option for you, there are several other ways for you to go about it. One can begin by identifying a particular topic, treatment, or issue that you have an interest in learning more about. Then, start by conducting a literature review. This is simply a search to see what has been written about your topic. If you have access to a computer at home or at your local library, you have all you need to

access PubMed, a free, online database from the National Library of Medicine. Additionally, many colleges and universities have a health sciences library with access to electronic versions of many of the peer-reviewed journals indexed in PubMed, such as the *Journal of Dental Hygiene*. Once you've done your search and collected your articles of previous studies or papers, you then write up a literature review, according to *Journal* submission criteria and then submit it to the a peer-reviewed publication. By simply adding a section identifying issues for research that you uncovered as a result of your review of the literature, you can conduct what is referred to as an integrative literature review. For example, many times one can think of other areas that need to be studied about a topic just by familiarizing yourself with what has been already investigated. What questions remained unanswered? The *Journal of Dental Hygiene* literature review guidelines require a review to include a summary and critique of the current status of the topic and the aspects needing further study. Literature reviews begin with a nonstructured abstract, which includes a brief statement of purpose, content summary, conclusions, and recommendations. At least 4 keywords should be listed following the nonstructured abstract.

Another way to contribute is by writing a short report that discusses a clinical case study, an educational innovation, a research method, a concept or theory, or other current topics. These are usually in the form of a case study or theoretical manuscript. A short report can be a great contribution. This is an opportunity to discuss ethical issues, treatments, and/or other important topics. Some examples could be the impact of socioeconomic on prevention, the failure of our government to recognize the equal importance of oral health care, or alternative models of dental care around the world.⁴

The profession needs to ensure that all dental hygienists have the knowledge and tools to contribute to dental hygiene research. The simplest way is to start with student dental hygienists and expose them to research as part of their education. Some programs already integrate research into their curriculum. It can be as simple as having a dental hygiene researcher come to a student organization meeting to share their experience and promote research as a viable and rewarding career in dental hygiene. Or, imagine the potential if all dental hygiene programs required the completion of a table clinic from their students. This would expose students to conducting research and give them the opportunity to submit their table clinic abstract for publication, creating a neophyte researcher, author, and beginning public speaker in one fell swoop. Perhaps they may not pursue research immediately, but they will be empowered knowing that they have the experience and can pursue it when the time is right for them.

In the reality of the 21st century health care, dental hygiene has a duty to become more engaged in research, especially at the translational and clinical levels, and there are ample opportunities for all to participate.⁴ Each day you practice brings experiences that may trigger ideas. All it takes is a spark. I find myself constantly jotting down ideas to pursue. If you find yourself wanting to do any or all of these things, but are still not sure how to proceed, consider reaching out to a mentor. The ADHA Research Resource Persons Network is a great place to start. Just remember, you can do it! However you choose to proceed, the following quote should become your mantra:

The contemporary hygienist cannot and should not be content with cleaning teeth and providing health information to patients in the operatory. The hygienist of the future must be an even stronger person of science who uses evidence to move patient care toward a new era of prevention, recognizing that genomics and proteomics will offer innovative solutions. This may require the hygienist to become a strategic advocate for consumer health and to gain a comfort level moving further out of the operatory.

Sincerely,

Danielle Furgeson, RDH, MS

Manager, Student Relations

American Dental Hygienists' Association

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Upfront

Katie Barge

Katie S. Barge is staff editor of the Journal of Dental Hygiene and staff writer for Access

Tooth Loss and Dementia May Be Linked

Tooth loss may predict the development of dementia later in life, reported researchers in the October issue of The Journal of the American Dental Association. Several past studies have shown that patients with dementia are more likely to have poor oral health. However, few researchers have examined the relationship to determine whether oral disease is a possible risk factor for developing cognitive impairments and dementia.

A team of researchers from the University of Kentucky College of Medicine and College of Dentistry investigated the relationships between tooth loss, dementia, and neuropathology in participants in the Nun Study, a longitudinal study of aging and Alzheimer disease among Catholic sisters of the School Sisters of Notre Dame.

The researchers used dental records and results of annual cognitive examinations to study participants from the order's Milwaukee province who were 75 to 98 years old. "Of the participants who did not have dementia at the first examination, those with few teeth (zero to nine) had an increased risk of developing dementia during the study compared with those who had 10 or more teeth," wrote the study's authors.

Dementia is a complex and multifactorial disease, and thus it is unlikely that one mechanism is completely causal. The researchers proposed several possible reasons for the association between tooth loss and dementia. In addition to periodontal disease, early-life nutritional deficiencies, infections, or chronic disease may result simultaneously in tooth loss and damage to the brain.

"Regardless of the issues of confounding and biological mechanisms, our findings suggest that a low number of teeth has an association with dementia late in life," concluded the authors. "It is not clear from our findings whether the association is causal or casual." The authors state that further studies are necessary to determine the true nature of the association between tooth loss and dementia.

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Review of: Concise Encyclopedia of Periodontology

Cathryn L Frere, BSDH, MSED

Reviewed by Cathryn L. Frere, BSDH, MSED, associate professor, Division of Dental Hygiene, West Virginia University School of Dentistry, Morgantown, WVa.

Concise Encyclopedia of Periodontology

Vandersall DC

Blackwell Publishing Professional

Ames, Iowa, 2007

219 pages, 223 illustrations, softcover

ISBN: 0-81382-602-0

\$69.99

After 35 years of practicing periodontics and clinical teaching, David Vandersall has written the first edition of the *Concise Encyclopedia of Periodontology*. This unique, condensed reference book was written primarily for undergraduate and graduate dental students, dental hygiene students, and their faculty. The concise quality also allows students involved with problem based learning, researchers, and clinicians to become quickly familiarized with periodontology.

The contents of the book are divided into 3 sections. First is the main portion of the book, the definitions of terms and procedures used in periodontology. Contained within the more than 700 definitions and brief descriptions are many diagrams, color clinical photographs, citations to historical and modern literature, cross references to associated terms and illustrations, and the names of contributors to the science of periodontology. The second section, the Appendix, alphabetically lists the authors of periodontal literature cited in the first section and gives an inventory of the terms included in the book that are associated with that author. The third section gives specific reference information, listed alphabetically by author, for the literature cited in the terminology section.

Definition headings are printed in blue, making them easy to identify. Although the book is not indexed, there is excellent cross-referencing of related terms. At times, content related to a cross-referenced illustration is difficult to locate either because the caption is not the same as the term being illustrated or the illustration number is not easily located within the text contents. Printing the illustration number within the text in a distinctive font or keeping the illustration caption consistent with its related definition heading would make linking the 2 easier.

The author's years of experience are evident in the many color case photographs which are very helpful to understanding the material. This culmination of many years of work also provides a valuable compilation of historical notes and periodontal references. The detailed coverage of traditional periodontal diagnostic and surgical methods is excellent, making this text especially useful to the dental student and dentist. In light of modern periodontal practice, however, terms related to the microbiology of periodontal disease, local delivery antimicrobials, immune response, and available new diagnostic aids are lacking.

Vandersall achieves the goal of providing a succinct, easily portable reference book with a presentation format especially helpful to the dental and dental hygiene student involved with problem-based learning and to the dental candidate preparing for board licensure and certification examinations. With respect the undergraduate dental hygiene student, the cost of the text may limit its use as a library resource to supplement their more instructive periodontal textbook related to entry-level dental hygiene clinical practice. This would make a good personal library resource for the dentist practicing outside the periodontal specialty, the student in a graduate dental hygiene program, or the dental hygienist working in a periodontal practice.

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Review of: Pain Control for Dental Practitioners: An Interactive Approach

Ruth Fearing Tornwall, RDH, MS

Reviewed by Ruth Fearing Tornwall, RDH, MS, Instructor IV, Lamar Institute of Technology in Beaumont, Tex.

Pain Control for Dental Practitioners: An Interactive Approach

Paarmann C and Royer R

Lippincott Williams & Wilkins

Baltimore, Maryland, 2008

128 pages, diagrams, indexed, softcover, CD-ROM, online resources

ISBN: 0-78177-914-6

\$54.95

The authors of *Pain Control for Dental Practitioners: An Interactive Approach* are of the opinion that as the demand for local anesthesia training has increased, so has the demand for faculty development, continuing education, teaching/learning materials, and readily accessible formal course work. As a result, they have produced a comprehensive teaching and learning package on pain control.

The instructional package was created specifically for dental/dental hygiene students, practicing hygienists preparing to take licensing exams, and/or students or practitioners needing a review in pain control techniques. In addition, this package may also be used to fulfill coursework required for licensure in individual states. The package includes an interactive CD-ROM and accompanying clinical manual.

Local anesthesia is often used in conjunction with nitrous oxide, so information on both procedures along with management of patient fear and anxiety, communications skills, risk management, and legal documentation is provided in the instructional package. The content within the CD-ROM is divided into 5 major sections. The sections include Local Anesthetic Agents, Injections, Potential Complications, Risk Management, and Nitrous Oxide/Oxygen Sedation. Each major section is divided into more detailed subsections. Each section includes course objectives, information on the CD-ROM, Predict Questions and Answers, and Quizzes with answer keys. Predict questions assist one in reviewing important facts and evaluating comprehension. Videoclips within the CD-ROM demonstrate on individuals the actual administration of individual local anesthesia injections and nitrous oxide techniques. The authors suggest this feature may eliminate the need to use live models for demonstration.

The *Supplementary Clinical Manual* summarizes the information in the CD-ROM into charts and tables, and works as a clinical reference. There are also handouts, sample self-assessment and evaluation forms, and learning activities provided in the CD-ROM.

This instructional package readily accomplishes its goal of providing a comprehensive instructional package on pain control for the dental/dental hygiene student and/or dental/dental hygiene practitioner. The content is up-to-date and presented in a concise and organized format. Basic theory and techniques are clearly explained and supported with videoclips. Reading and following the directions for the instructional package is extremely important in order to be successful in its use. This package would be an asset to any dental professional library.

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Review of: Special Care Dentistry

Jackie Carpenter, DA, RDH

Special Care Dentistry

Fiske J, Dickinson C, Boyle C, Rafique S, Burke M

Quintessence Publishing Co. Ltd.

Carol Stream, Ill, 2007

152 pages

ISBN: 1-8509-7134-4

\$54.00

The *Special Care Dentistry* volume in the QuintEssentials series is successful in outlining the demography of disabilities in the United Kingdom and the need for special care. The increased awareness in Britain and the United States for quality care dentistry for special needs patients is at an all-time high and this need will continue to increase around the world. The 12 chapters in this book quickly bring attention to defining disabilities and impairments in clinical practice in Britain in a comprehensive and easy-to-read text. They each have an aim, outcome, and an introduction. They are supported by quality illustrations and further reading resources. All chapters give tangible information to manage patients with disabilities in Britain or the United States.

There are many special patients who require a wide range of care from sensory, physical, or mental impairments. This can also include the patient having radiotherapy or the patient requiring antibiotics before treatment. These patients require dental personnel with special skills, knowledge and a caring touch. This knowledge can be used to communicate with sign language as described in Chapter 3; understand learning disabilities such as Down syndrome or Autism in Chapter 4; or to recognizing signs of mental illness detailed in Chapter 5. Patients having pronounced gag reflexes are discussed in Chapter 10, where the authors suggest techniques such as relaxation, distraction, and sometimes even acupuncture. This volume is overflowing with information that will excite the dental professional because this information can be used today.

Chapter 2 stands out in managing patients with physical disabilities. This includes access to care barriers, clinical provisions to consider, and oral hygiene aids. A difference from the United States is noted in this chapter called domiciliary dentistry. In Britain, this is dental house calls with portable equipment units that can include high and low speed handpieces. Restorative procedures are possible and ultrasonic scalers can be used. People with disabilities and significant mobility problems are treated by the Community Dental Services (CDS) in their homes. The CDS is a salaried, primary dental care service provider. Although these dental personnel are experienced in specialized dentistry through their work, they are not professionally recognized in the United Kingdom. The United States has many different organizations that serve the disabled, although these are usually done in clinics, hospitals, or individual dental offices. The Special Care Dentistry Association and the National Foundation of Dentistry for the Handicapped (NFDH) are 2 groups that are found in the United States that focus on dental care for the disabled. NFDH volunteers make house calls in Chicago, Denver, and New Jersey. Both of these organizations have networked with many health care professionals to assist the disabled in their oral

health. There are component interest groups on their Web sites as well. The need is great for more research and growth in this area.

I would greatly recommend this volume in the QuintEssentials series to all dental personnel. It is a must-have for the office for quick reference to many of the impairments we see and deal with on a daily basis.

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The Cruzan Center for Dental Research

Caren M Barnes, RDH, MS

Caren M. Barnes, RDH, MS, professor and coordinator of clinical research, University of Nebraska Medical Center College of Dentistry

Research is an integral part of the University of Nebraska Medical Center (UNMC) College of Dentistry's mission and strategic plan. The College of Dentistry (COD) has experienced substantial growth in its research enterprise since the opening of the Cruzan Center for Dental Research (CCDR) as evidenced by a 16-fold growth in extramural funding from 1998 to 2006. Through major investments from the COD, UNMC, and the generosity of UNMC College of Dentistry alumni and their spouses Dr. and Mrs. Winston V. Cruzan and Dr. and Mrs. Gene Dixon, funds were allocated for the building of the Cruzan Center for Dental Research. The CCDR is a state-of-the-art facility that serves as the central unit for research and has 2 components: the clinical research component and the basic science component. The primary funding source for the clinical component is industry, while the basic science component is primarily funded by NIH, but also receives some funding from other government and industrial sources.

The CCDR Clinical Component

Due to the structure of the Cruzan Center, the COD faculty have the opportunity to collaborate on a variety of clinical research projects that include investigators from multiple disciplines, such as medicine and pharmacy. Additionally, investigators from the COD collaborate with other dental schools and medical and dental healthcare providers in the local community.

In 1998, Caren M. Barnes was named Coordinator of Clinical Research for the Cruzan Center of Dental Research and was the first dental hygienist to lead a clinical research facility in a US dental school. I am a member of the Association of Clinical Research Professionals and have extensive experience in the design and participation in clinical research and has strong relationships with dental industry that have resulted in sustained funding for over 30 years. My approach to the Cruzan Center was to provide comprehensive infrastructure support to faculty participating in clinical research in order to maximize their efficiency and time while meeting the timelines of industry, government, and the dental community. Services the CCDR provides for investigator-initiated studies include: literature searches, preparation of grant applications and applications for regulatory agencies (IRB, Pharmacy and Therapeutics Committee, FDA, etc), as well as protocol design, statistical design and analysis, budget preparation, identification of funding sources, and database development for clinical outcomes trials. Many of these same services are provided to industry for industry-initiated projects. Strong community networks have enabled the Center to recruit a culturally diverse population of subjects.

The faculty that have participated in clinical research have a broad area of expertise in clinical research in the following areas:

- Randomized clinical trials, multi-center trials
- Dental Instruments/Equipment
- Etiology of Oral Diseases

- Oral Hygiene Devices
- Oral Pharmaceuticals
- Dental Materials and Biomaterials

Notably, since 1998, a large portion of clinical and applied research funding has come from the participation of dental hygienists in clinical research at the Center. The following is a representative example of research conducted at the CCDR that dental hygienists participated in as a principal investigator or participating personnel:

- A Comparison of the Efficacy of a Rowenta Powered Toothbrush (MH700) and the Oral B Braun Powered Toothbrush in Affecting Plaque Accumulation and Gingival Bleeding
- A Clinical Evaluation of the Efficacy of a Plastic Prophylaxis Polishing Cup Compared to a Conventional Natural Latex Prophylaxis Polishing Cup
- The Effects of Aluminum Trihydroxide Airpolishing Powder on Dental Restorative Materials and Enamel
- A Comparison of a Waterpik Double-Motor Powered Toothbrush and a Manual toothbrush in Affecting Interproximal Bleeding Reduction and Plaque Accumulation
- An Examination of the Effect of the sonicare Powered Toothbrush on Salivary Flow on Patients With Xerostomia Secondary to Head and Neck Radiation Therapy
- A Comparison Of Irrigation To Floss As An Adjunct To Toothbrushing: Effect On Bleeding, Gingivitis and Supragingival Plaque
- The Effects of NUCare Root Conditioner on Gingival Healing
- The Application of Computer Aided Cytology for Detection of Precancerous and Cancerous Lesions of the Oral Mucosa: A Multicenter
- A Randomized, Investigator-Masked, Multicenter Study to Compare the Safety and Efficacy of Nystatin Oral Suspension and Nystatin Frozen Oral Suspension in the Treatment of Patients with Oral Candidiasis
- A Phase III, Multicenter, Randomized, Double-Blind, Placebo-Controlled Study to Assess the Efficacy and Safety of Cevemeline in the Treatment of Zerostomia Secondary to Radiation Therapy for Cancer in the Head and Neck Region
- A Qualitative Evaluation of the Abrasiveness of Selected Prophylaxis Pastes When Used on Enamel, A Hybrid Composite and Porcelain Using a Non Contact Profilometer and Glossmeter
- A Qualitative Evaluation of the Abrasiveness of Selected Prophylaxis Pastes When Used on Enamel, A Hybrid Composite and Porcelain
- A Laboratory Assessment of the Efficacy of the Summit+ Compact Toothbrush Compared to the Oral-B 35 Indicator

The CCDR Basic Science Component

The basic science component of CCDR is comprised of faculty that have 3 major units of focus: bioregulation, biomaterials, and cellular signaling in cancer. The faculty from the CCDR basic science component receive the majority of their funding from NIH and additional funds from foundations and industry. The COD has been ranked in the top 30 US dental schools in NIH funding for 6 consecutive years, which is remarkable as the COD has one of the smallest faculty sizes.

Many of the NIH-funded research studies conducted by the bioregulation unit have investigated various aspects of periodontal disease. Recently completed was an NIH-funded study by Jeffrey Payne, DDS, M Dent Sc, and Richard Reinhardt, DDS, PhD, that investigated the effects of low-dose doxycycline on osteopenic bone loss in post-menopausal women. Other NIH- funded studies have included translational research investigating the effects of periodontal therapy in private practice on glycosylated hemoglobin levels of diabetic patients, lymphocyte subpopulations in periodontal tissues, supportive periodontal therapy during estrogen deficiency, and novel pharmaceutical methods to augment bone growth in the oral cavity.

Biomaterials research is one of the fastest growing areas at the College of Dentistry. At present, research efforts fall into 1 of 4 general categories: biomechanics, mechanical and physical testing of biomaterials, biological response evaluation, and outcomes assessment (clinical trials). The research focus in biomechanics includes TMJ function, tooth wear, and cavity preparation design.

The TMJ research focuses on the long-term health of the synovial joints, mechanical stress, and its resulting deformation of lining tissues that are important factors in the generation of fluid transport and nutrition for the articular tissues. This research utilizes techniques such as computer generated numerical modeling of muscle and joint forces and in vivo testing (human) of computer modeling predictions to explore the mechanisms controlling stresses in the TMJ. Research on tooth wear is investigating the significant losses of tooth structure that can occur with occlusal and incisal wear and the etiology and mechanisms that govern wear. The extent of tooth wear is currently evaluated by means of qualitative or ordinal scales that are insensitive to small changes in loss of tooth structure that cannot ascertain the rate of wear. These problems are being addressed by the development of a quantitative measuring method that uses a computer-aided-design (CAD) software program to record and model the incisal and occlusal wear facets of the human dentition. When fully developed, this system will allow the location, size, and distribution of wear facets to be recorded, as well as determining the rate of wear. The effect of dental treatment and disorders like bruxism and bulimia on the loss of tooth structure are some of the areas that could apply this technique. Cavity preparation design is being investigated relative to the life span of dental restorations. Current life-span predictions are based on clinical evaluation that in general does not account for the amount of tooth structure removed during the operative process. Present research efforts are aimed toward determining the volumetric changes that occur when tooth structure is removed during various tooth preparation procedures. Future research will focus on determining the fatigue resistance of prepared teeth with various cavity preparation sizes. This will ultimately permit the development of a failure prediction model for teeth that are candidates for given cavity/crown preparation procedures. Restoration life-span information could allow the dentist and patient to make more accurate treatment planning decisions.

The Nebraska Center for Cellular Signaling (NCCS) was formed in the fall of 2003 creating a Center of Biomedical Research Excellent (CoBRE) under the IdeA program, which is funded by the NIH and the National Center for Research Resources. A number of areas within the field of cell biology are rapidly converging on a common theme: cellular signal transduction. This is particularly true for the fields of cell adhesion, cell motility, and cancer biology. The main focus of this Center is to bring together individuals studying signal transduction to form an organized, cohesive group. The project leaders of this Center share interests in cell motility, cell adhesion, growth regulation, apoptosis, metastasis, and invasion. A thread that ties this group together is their desire to understand signaling pathways that impact cellular behavior as well as the underlying theme of signaling through adhesion receptors and receptor tyrosine kinases.

This is a very exciting time in dental research and there is so much to explore and so many questions to be answered. Whether in a state-of-the-art laboratory or clinical facility, the University of Nebraska Medical Center College of Dentistry is fortunate to have faculty expertise, dedication, and outstanding facilities so that we may contribute to the ever burgeoning scientific body of knowledge of dental hygiene and dentistry.

Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2007

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Bone Density and Consumption of Cola Beverages

Karen B Williams, RDH, PhD

Karen B. Williams, RDH, PhD, is a professor and director of the Clinical Research Center at the University of Missouri-Kansas City. She received her certificate in dental hygiene and BS in education at The Ohio State University, her MS in dental hygiene education at the University of Missouri-Kansas City, and PhD in evaluation, measurement and statistics at the University of Kansas. Dr. Williams has been active in clinical dental hygiene for over 35 years and in clinical research for 23 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health outcomes research, and clinical dental hygiene. She is a research consultant for numerous dental manufacturers. Dr. Williams has presented papers and continuing education programs throughout the United States and internationally.

The purpose of *Linking Research to Clinical Practice* is to present evidence-based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.

Evaluation of the effect of cola drinks on bone mineral density and associated factors.

Ogor R, Uyall B, Ogor T, Yaman H, Ozlas E, Ozdemir A, Hasde M. Basic and Clinical Pharmacology and Toxicology. 100:334-338, 2007.

Department of Environmental Health, Gulhane Medical Faculty, Ankara Turkey.

Abstract

Background. The aim of this study was to determine bone mineral density changes caused by consumption of cola drinks and the associated factors.

Methods. Thirty Sprague-Dawley rats were divided into four groups. Groups 1 and 2, consisting of 10 male and 10 female rats, respectively were provided with as much food, water and cola drinks as they wanted. Groups 3 and 4, consisting of 5 rats each, received only rat chow and water. The bone mineral density of the rats was measured using dual energy X-ray absorptiometry at the end of 30 days. The blood values and weights of the animals were also determined. The esophagus and kidneys were removed for histopathological examination.

Results. The weight gain was higher in the groups consuming cola drinks than the control group rats ($p < .05$). Water consumption decreased 5.9 times while total fluid consumption increased 1.6-1.9 times in the group consuming cola drinks. No significant change was detected in the blood calcium levels. There was a significant decrease in the bone mineral density of test groups when compared to the control groups ($p < .05$). While we did not detect any pathological esophageal changes in the rats consuming cola drinks, examination of the kidneys revealed general glomerular congestion and intertubular bleeding.

Conclusions. We suggest that the decrease in bone mineral density might be related to the renal damage caused by cola drinks in addition to other related factors.

Commentary

Consumption of carbonated beverages continues to be of concern to health professionals as they have been linked to both dental caries and obesity. This study used an animal model to explore the potential for a causal relationship between bone mineral density and cola beverage consumption. The animal model design allowed researchers to control the animals' exposure to dietary forms of phosphoric acid other than that present in the cola. The cola was purchased from a public market and is a popular brand that is available worldwide. Additionally, the researchers periodically alternated the location of the water and cola containers in the animal enclosures to prevent animals returning to the same drinking location simply due to habit. It is important to note that the animals were given free access to as much food and water as they wanted, and for the test group, free access to cola as well. Animals were weighed twice weekly over the 30-day period, and then anesthetized to obtain bone mineral density measures, blood samples, and tissue samples. Change of pH in the cola beverage began immediately upon opening and was assessed over a 20-hour period.

Results from this study showed that, in the cola test group, females consumed significantly more ($p < .05$) cola than the males, at 76.2 mls versus 55.3 mls. Concomitantly, water consumption in this group decreased by 5.9 times, whereas total fluid consumption increased by 1.6 to 1.9 times. Both male and female rats having free access to cola gained more weight than the control rats, and these differences were statistically significant ($p < .05$). Moreover, the cola-consuming rats (both male and female) had a statistically significant decrease in bone mineral density (approximately 20% lower) compared to the control rats, although their serum calcium levels were not significantly different. Histopathological examination of the esophagus did not reveal any changes; however, there was evidence of renal damage in the cola-fed rats. The pH levels of the colas over the 20-hour period varied slightly between 1.4 and 1.7, but were not significantly different.

The authors compared their results to previously published studies in this area, and while there were some differences in outcomes among studies, the decrease in bone mineral density of about 20% for test rats were consistent with results obtained in previous studies. A hypothesized reason for this is that the high phosphate and high caffeine in colas may result in an increased acid load in the body, which can influence the calcium/phosphorous ratio and bone mineral density. The results regarding renal damage were not directly attributed to changes in bone mineral density, although the authors do propose the need for future studies to determine whether kidney damage might result in changes in the mineral balance of the body, which might influence bone mineral density. One issue not addressed by the authors was that the rats having free access to cola also consumed considerably more fluid overall than the control group rats. Whether this might influence renal damage and function is not discussed. Overall, this study does provide preliminary evidence of a relationship between cola consumption and bone mineral density in a rat model. As always with animal studies, one must be cautious in generalizing these results to a human population.

Colas, but not other carbonated beverages, are associated with low bone mineral density in older women: The Framingham Osteoporosis Study

Tucker KL, Morita K, Qiao N, Hannan MT, Cupples A, Kiel DP. American Journal of Clinical Nutrition 84: 936-942, 2006.

Department of Environmental Health, Gulhane Medical Faculty, Ankara Turkey.

Abstract

Background. Soft drink consumption may have adverse effect on bone mineral density (BMD), but studies have shown mixed results. In addition to displacing healthier beverages, colas contain caffeine and phosphoric acid (H₃PO₄) which may adversely affect bone.

Objective. We hypothesize that consumption of cola is associated with lower BMD.

Design. BMD was measured at the spine and 3 hip sites in 1413 women and 1125 men in the Framingham Osteoporosis Study by using dual-energy X-ray absorptiometry. Dietary intake was assessed by food-frequency questionnaire. We regressed each BMD measure on the frequency of soft drink consumption for men and women after adjustment for body mass index, height, age, energy intake, physical activity score, smoking, alcohol use, total calcium intake, total vitamin D intake, caffeine from noncola sources, season of measurement, and for women, menopausal status and estrogen use.

Results. Cola intake was associated with significantly lower ($p < 0.001-0.05$) BMD at each hip site, but not the spine, in women but not in men. The mean BMD of those with daily cola intake was 3.7% lower at the femoral neck and 5.4% lower at Ward's area than those who consumed <1 serving cola per month. Similar results were seen for diet cola and, although weaker, for decaffeinated cola. No significant relations between noncola carbonated beverage consumption and BMD were observed. Total phosphorus intake was not significantly higher in daily cola consumers than in nonconsumers; however, the calcium-to-phosphorus ratios were lower.

Conclusions. Intake of cola, but not of other carbonated soft drinks, is associated with low BMD in women. Additional research is needed to confirm these findings.

Commentary

Osteoporosis and associated bone fractures are important health issues for older adults. Hip fracture in older adults is associated with a risk of mortality of up to 20%. Previous studies suggest that cola consumption may predispose teenagers to increased risk of fractures; however, few studies have examined this effect in an adult population. The rationale for the current study was based on previous studies that suggest that phosphoric acid might decrease calcium absorption and interfere with normal mineral balances in the body. In addition, caffeine, which is present in cola drinks, has been associated as a risk factor for osteoporosis. These authors examined the hypothesis that cola beverages may increase individuals risk for low BMD in a large, federally funded nutrition study. The Framingham Osteoporosis study is a third generation study that includes a sample of offspring from the original 1948 Framingham Heart Study (FHS). In 1971, 5124 adult children of FHS participants were enrolled in the Framingham Offspring Cohort Study. Over the intervening 3 decades, these subjects were followed and examined at 7 different intervals. The data presented in this study were collected between 1996 and 2001 on subjects who were still being followed in the Cohort study and were not taking medications such as bisphosphonates, selective estrogen receptor modulators, or calcitonin, which might influence results. Standard methods were used to determine BMD. Dietary data were collected using a validated, 126-item questionnaire that queried subjects on frequency of food and beverage consumption. In order to account for other factors that might influence the results, the authors also obtained extensive information on health-related behaviors, physical status measures, and demographic variables.

The average age (SD) of female participants was 58.2 (9.4), with men being comparable at 59.4 (9.5). In addition, body mass index scores (BMI) were similar between gender groups, with men being slightly greater. Overall, women had lower BMD, lower physical activity scores, less caffeine intake, and less calorie intake than men. Women, did however have, on average, a higher intake of calcium and vitamin D. With regard to average consumption of carbonated beverages, men consumed 6 servings per week compared to women's 5 servings. Of those, colas comprised the most common selection of carbonated beverages. Multiple linear regression was used to predict BMD as a function of cola consumption while controlling for other relevant factors. Multiple linear regression is a well-accepted statistical strategy used to predict health outcomes while controlling for other explanatory factors. Given the sample size used in this study, one can expect that these analyses would provide stable estimates for associations under scrutiny. The results showed that there was not a significant association between carbonated beverages, in general, and BMD. However, in women there was a negative association between cola consumption and BMD such that higher consumption was associated with lower BMD. This association persisted for diet colas and decaffeinated colas. One result that gives additional support to this relationship was that caffeinated colas were more strongly associated with lower BMD than decaffeinated colas. Of interest, these associations were not observed in men.

The authors were quick to point out that higher cola intake was not related to lower milk intake, which has been considered in previous studies as a plausible factor in decreased BMD. Results from this study showed a consistent effect of cola consumption on lower BMD in women, even when decaffeinated colas were considered. They propose that the phosphoric acid, caffeine, and cola extract present in colas but not in other carbonated beverages to the same degree, are likely reasons

for decrease in BMD. Clearly, caffeine and phosphoric acid are biologically plausible culprits; however, not much is known about cola extract and what systemic effects it might have. Previous studies have shown that beverages with both phosphoric acid and caffeine increase urinary calcium excretion, which might be a reason for the reduced BMD. The authors conclude that women who are concerned about osteoporosis should avoid consumption of cola beverages.

The Bottom Line

Dental hygiene clinicians are often faced with patients who have high caries rates associated with consumption of sugar-sweetened cola beverages. A common recommendation during oral health education is to switch to diet cola beverages, and thus reduce risk for decay. However, as dental hygienists assume a greater role in the area of health advocacy, such recommendations may not be prudent given recent evidence on cola consumption and systemic health. In the past decade, significant shifts have occurred in dental hygiene practice where clinicians serve as a knowledge resource for their patients in areas that extend beyond the traditional boundaries of "the mouth". Certainly, one area in which this shift has occurred is in the area of periodontal disease and systemic health, particularly in cardiovascular, reproductive, and endocrine health. These 2 studies provide evidence that phosphoric acid and caffeine in colas, irrespective of whether they are sugar sweetened or not, may predispose individuals to BMD health risks.

Whether the link between consumption of cola beverages and BMD is causal or not, these 2 studies provide evidence that cannot be ignored. The role of the dental hygienist in providing accurate information and valid health recommendations is important. In patients with high caries rates, the dental hygienist should provide counseling on exposure to sugar in colas, but should also consider that the phosphoric acid and caffeine in sugared, artificially sweetened, and decaffeinated colas may predispose women to changes in BMD above those associated with hormones, diet, and activity level.

Therefore the following recommendations can be made based on the findings in these 2 studies:

- Consumption of cola beverages is a statistically significant and independent risk factor for lower BMD. This relationship is evident in an animal model as well as for women, in the human model.
- The mechanism by which cola beverages might influence BMD is still unknown, but may be related to change in the calcium/phosphorus ratio systemically.

Summary

The practice of dental hygiene continues to evolve as new evidence is published. Recent studies suggest that diet and decaffeinated cola beverages along with sugar sweetened colas may be a risk factor for lower bone mineral density, especially in women. This evidence has implications for clinicians who play a critical role in educating patients. When providing dietary recommendations for patients with high caries rates who consume cola beverages, clinicians should be cautious in recommending diet cola beverages. Certainly there is a need for additional research into the mechanism for this effect and to determine if occasional consumption of colas is a health risk.

Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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The utilization of Computer Mediated Communication for case study collaboration

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Computer Mediated Communication (CMC) can be used as an effective tool for student communication and collaboration. First-year, first-semester dental hygiene students self-selected groups to develop dental hygiene process of care treatment plans, written reports, and oral case presentations based on assigned clinical cases. In consultation with the University of Michigan (UM) Digital Media Commons Collaborative Technologies Teams, CMC options were identified. Two chat rooms were established within the UM's Course Management System (CTools) to provide opportunities for synchronous (simultaneous, real-time) communication. One course blog site and 8 case blog sites were developed to provide students and instructors with electronic asynchronous (nonsimultaneous) communication formats. The purpose of this study was to evaluate the effectiveness of these technologies during group case study projects. CMC has the potential to provide an effective means of collaboration and communication when the technologies align with the purpose of the project and compliment the dynamics of student groups.

Keywords: Computer Mediated Communication (CMC), chat room, blog, case-based learning

Background

Small-group teaching methods emphasize teamwork and problem solving. In case-based learning, discovery is encouraged in a format in which students and facilitators share responsibility for identifying principle learning points.¹ Advanced preparation helps the learner to focus on key points of a clinical case. This encourages a structured approach to clinical decision making and allows learners to become the content expert for the case.¹

Collaborative problem solving skills are considered necessary for success in today's world. Collaborative problem solving is defined as activities that involve interactions among a group of individuals. Education is increasingly integrating collaborative group tasks in which students work together to solve problems or to accomplish projects.²

Increasing the potential for interaction and collaboration among participants, electronic technologies and the Internet provide opportunities to move away from the traditional classroom into educational environments that have no physical boundaries. Through previous course evaluations, students identified that meeting with group members posed a challenge due to time constraints when on campus, impeding the progress and thoroughness of the project. Computer Mediated Communication (CMC), such as chat rooms and blogs, presented a solution to this issue.

A chat room is a form of text-based conferencing. Chat room discussion offers an opportunity for synchronous (simultaneous, real-time) communication. The use of this technology for small group discussion offers an alternative to face-to-face meetings. Chat room experiences can serve to provide social interactions that are crucial for learning.³

Blog is the abbreviated name for "Weblog." The Weblog, beginning as an asynchronous (non-simultaneous) online journal, is now thought of as a Web-based electronic bulletin board. It serves as a user-generated Web site where entries are made in journal style and displayed in a reverse chronological order. A typical blog combines text, images, and links to other blogs, Web pages, and media related to its topic. The ability for readers to leave comments in an interactive format is an important part of many blogs. Time and date stamping of entries and archiving of past entries are distinctive features of Weblogs.⁴

A beneficial factor related to blogging is the automated syndication of content. An "aggregator" allows one to subscribe to blogs allowing the content for each blog conveniently available in one place. "Subscription" to an aggregator is accomplished by adding a URL or XML/RSS button from various sites. RSS (Real Simple Syndication) is a method of Web contents syndication. By using an aggregator, a reader can quickly survey their subscriptions and receive notices of new content.⁴

Twenty-eight first-year, first-semester dental hygiene students, enrolled in a residential (face-to-face) course were provided an opportunity to synthesize foundation knowledge into the development of dental hygiene process of care treatment plans through case-based learning. The purpose of this study was to evaluate the effectiveness of 2 Computer Mediated Communication (CMC) technologies-chat rooms and blogs-for group case study collaboration.

Review of the Literature

Factors have been identified related to student and instructor perceptions of CMC and the role it plays in shaping online discourse. Four important factors have emerged:

- the nature of the course, especially how class time is structured and how the purposes of the course are presented and understood by the students;
- students' sense of their roles as participants in course-related discourse, both in-class and online;
- students' perceptions in general of CMC as a communication medium;
- student perception of CMC assignment and management by the instructor.⁵

The successful use of technology in the classroom is linked to the concept of connectivity. Connectivity is the students' and instructors' ability to encourage the use of course materials in novel ways with technology linked to enhancing the learning process.⁶ The 5 points of connectivity include: communication, collaboration, motivation, integration, and creativity.

Technology chosen should facilitate communication between students and instructors. Emerging technologies such as chat rooms and blogs are becoming more popular as they allow student participants to communicate freely, and to add to and update content while allowing for creativity of expression.⁶ Technology should encourage not only discussion and feedback, but also collaboration among all students and instructors. Instructors should be proactive in requiring students to learn technologies that may improve their understanding of course material. It should support communication for the active learning process, including brainstorming, to determine what is known and what is needed to be known.⁷

Providing instruction on the use of technology and incorporating this within the grading process provides motivation for student use.⁶ One of the most effective ways to encourage use of a technology is through an experiential project. In case-based learning projects, technology is best utilized in enhancing group interaction and discussion.⁷ CMC offers opportunities for on-demand delivery of text and video, in addition to allowing participants to create and store digital records of group sessions.⁷

Chat rooms are a synchronous CMC. They offer an authentic means of social interaction in the absence of a face-to-face meeting.³ Discussion is best facilitated in this format if interaction is guided by a common goal. With synchronous technology, students take the initiative and responsibility to arrange a meeting time so that all can be present in the chat room for discussion. When the goal of the discussion is defined and the appropriate members are present, chat rooms allow for the negotiation of understanding of course material in a way that supports meaningful learning.³

Blogs used in education are rapidly emerging as educators embrace the instructional potential of this online tool.⁸ Blogging as a classroom application allows for enhanced communication and comprehension among students, creating a collaborative learning community.⁹

When used as an electronic bulletin board a blog provides a fast, efficient means of communication. When used as an educational resource, instructors can post additional information, explanations, or examples to reduce confusion related to assignments and projects. As a collaborative tool, a blog may be dedicated solely to a topic or project, with groups of students using a site as a common medium for completing an assignment.⁸ Blogging can provide a means of ongoing communication with group members of a project team that would not otherwise be available unless the team members met face-to-face.⁹

Four benefits have been identified with the use of blogs by students:

- Blogging has been cited as a motivating tool because of its newness.
- The use of blogs gives students legitimate chances to participate. The goal of teaching and learning is to integrate students into a community of practice, opening up a world beyond the traditional teacher-student relationship.
- The use of blogs helps students become subject matter experts. The blogger is involved in filtering information to utilize the most relevant, with postings reflecting the best content for discussion.
- The use of blogs provides opportunities for diverse perspectives. Often time and curriculum constraints do not provide an opportunity for every student to share thoughts in a traditional classroom.¹⁰

Blogs can be commented on, providing opportunities for feedback and scaffolding of new ideas. Hyperlinks can be included in blogs, which can assist students in identifying supporting and new information, assisting in knowledge construction.¹⁰

Methods

Two faculty members responsible for first-year, first-semester dental hygiene courses worked in partnership to align their individual course contents for students' participation in the case study project. Twenty-eight students self-selected partners, establishing 2-person groups. Students were provided with case assessment documentation that included a medical-dental history, oral examination form, periodontal chart, radiographs, and intraoral photographs. Each group was responsible for 1) participation in an online "patient" interview; 2) completion of a dental hygiene process of care treatment plan; 3) written report expanding information included in their treatment plan; and 4) an oral case presentation to the class. The objective of this case study project was to provide first-year, first-semester students with collaborative treatment planning experiences prior to their entry to direct patient care.

In consultation with the University of Michigan Digital Media Commons Technologies Teams, Computer Mediated Communication (CMC) options were considered to address student collaboration concerns related to real-time scheduling for project activities. Chat rooms and blogs were identified as 2 CMCs that would address the students' needs. Two chat rooms were added to the class course management system site (CTools). Using mBlog, a blogging service available to students, faculty, and staff at the University of Michigan, one course blog site and 8 case blog sites were developed. Each blog site was provided a link to the class Course Management System (CTools) site. Within the password-protected CTools site was posted assessment documentation for each case.

In order for instructors to easily track postings on all 9 blog sites, a blog aggregator was used. "Bloglines," a free Web-based service, allows the user to track blogs, news, podcasts, etc, in one site. When new content was added, a subscriber's list of feeds becomes bold, eliminating the need for instructors to log onto individual blog sites.

Case-related blogs were available for multiple purposes. One purpose was to serve as an extension of the "patient" interview, with an opportunity for students to pose questions related to the medical-dental histories and the oral examination. One course instructor served as each "patient," responding to questions and comments posted in mBlog case sites. Students assigned to the case could read entries and post entries and comments. Case blog sites, along with CTools chat rooms, were intended as a means for project team member communication and collaboration. The case study project, from initial orientation workshop to oral case presentation, spanned 7 weeks.

A base line survey was conducted at the initial orientation of first-year dental hygiene students prior to classes beginning. Questions were structured to determine students' technology ownership, understanding, and type of Internet service provider. Also included were questions related to use and frequency of technology communication tools.

Prior to the initiation of the case study project, a University of Michigan Instructional Technology Librarian conducted a 90-minute orientation workshop for the dental hygiene students. Included in the workshop was the process of utilizing the 2 chat rooms established within the class CTools course management site. This session also covered accessing the class and case mBlog sites, posting new entries, and comments. The public aspect of mBlog was identified within this session and students were informed that cases used for this project were fictitious. The session also provided a discussion on responsible computing practices and etiquette related to the use of these technologies.

Students surveyed after the workshop provided feedback on their knowledge level before and after this session, along with their confidence in submitting a blog entry and accessing CTools Chat. At the completion of the project, students were again surveyed. The questions on this survey were expanded to cover not only technology-related issues, but also the learning effectiveness of the case study project.

To provide an opportunity for expanded student feedback on this project, a focus group was conducted 3 weeks after the end of the project and final survey. A 1-hour focus group with 10 volunteer students was facilitated by the University of Michigan School of Dentistry Director of Dental Informatics. This provided students an opportunity to provide an enhanced explanation to the answers provided in the end-of-project survey.

Results

In an initial dental hygiene computing survey, 80% of the first-year dental hygiene students indicated they had high speed Internet available at home, with 5% reporting dial-up Internet access. Of the 2 Computer Mediated Communications identified for the case study project, 86% of the students had never used a blog, and 96% had not participated in a chat room (Figure 1). Students surveyed pre-and post-mBlog/CTools Chat Orientation Workshop indicated an 80% knowledge/confidence level for mBlog use, and a 100% knowledge/confidence level for CTools Chat at the completion of the orientation workshop (Figure 2a & 2b).

Figure 1. Initial Dental Hygiene Computing Survey

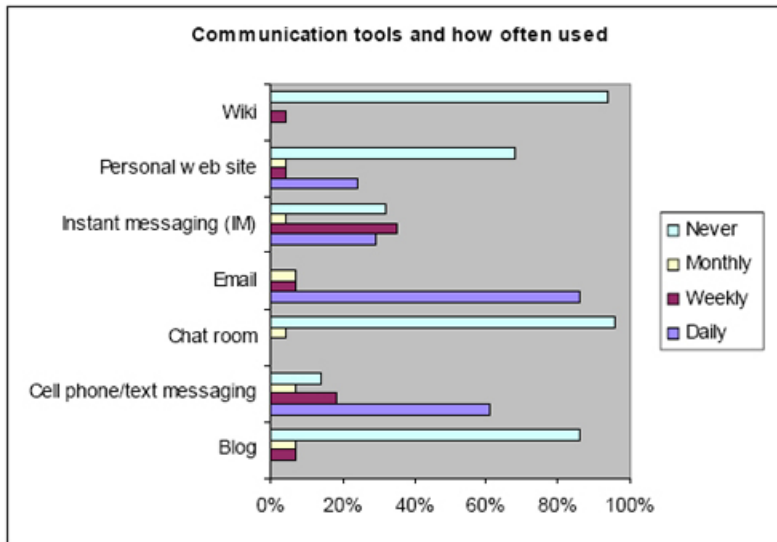
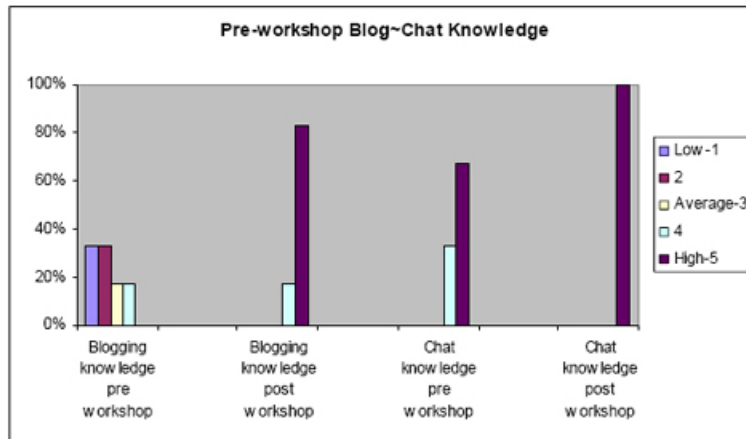
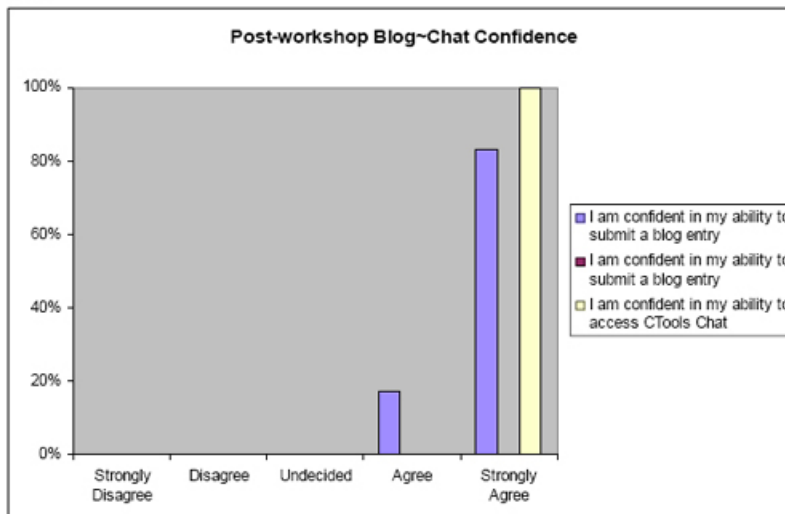


Figure 2 (a & b). mBlog/CTools Chat Orientation Workshop Survey Results

2a.



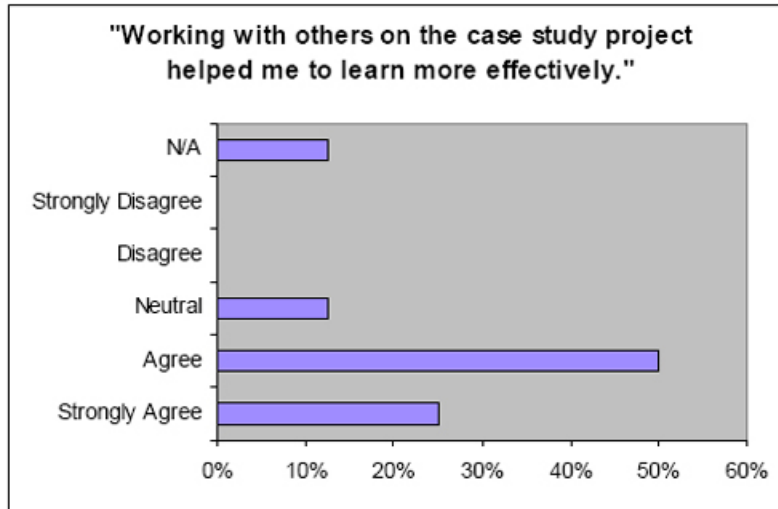
2b.



Eighty-three percent of the students strongly agreed they were confident in their ability to submit a blog entry, and 100% strongly agreed in their ability to access CTools Chat when again surveyed at the end of the project. When asked if the case study process helped students to learn course material, 75% agreed. Seventy-five percent agreed that working with other students on this project enhanced learning effectiveness (Figure 3a & 3b). Students surveyed continued to identify the mBlog/CTools Chat Orientation Workshop as a valuable session, requiring little to no additional technical assistance to utilize these technologies (Table I).

Figure 3 (a & b). Case Study Project Effectiveness and Learning Results

3a.



3b.

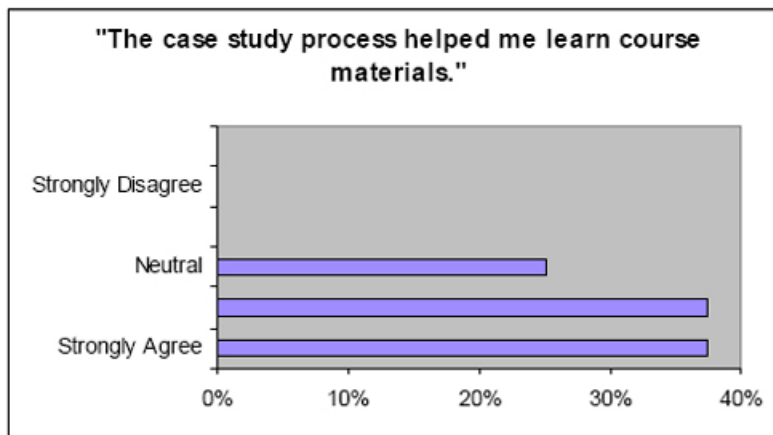
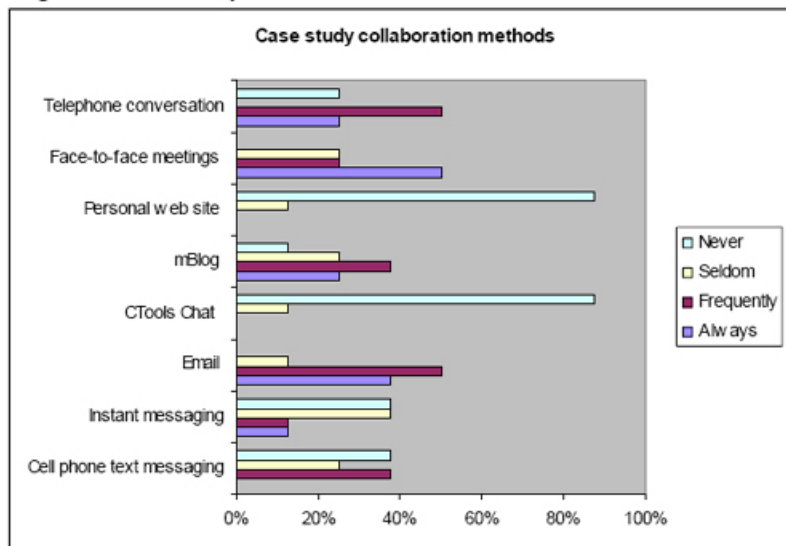


Table I. mBlog/CTools Chat Utilization During Case Study Project

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
mBlog~Chat Orientation Workshop provided a valuable introduction to electronic communicating and collaboration options	25%	37.5%	37.5%			
I required technical assistance to work with collaboration technologies during the case study project.	12.5%		12.5%	25%	50%	
I participated actively in case study discussion through the use of mBlog.	50%	25%	25%			
I participated actively in case study discussion through the use of CTools Chat.			25%	25%	25%	25%
mBlog discussions were a valuable part of the case study project.	50%	37.5%	12.5%			
CTools Chat discussions were a valuable part of the case study project.			50%			50%

Seventy-five percent of the students strongly agreed that mBlog discussions were a valuable part of the project and actively used this technology. CTools Chat, however, was not utilized and was not identified as a valuable technology for collaboration in this project. Students surveyed at the end of the case study project indicated face-face-meetings and telephone conversations were the formats used most often for collaboration (Figure 4), followed by email, blogs, and instant messaging.

Figure 4. Case Study Collaboration Methods



The use of mBlog was utilized exclusively for communication with case study "patients" and inquiries related to case study project format. Student mBlog postings totaled 81. Twenty-two out of 28 students (79%) participated in mBlog case sites communication. The average number of postings per student was 3.6, with one student posting 14 entries. Group members could self-select if one or both members would be responsible for posting in mBlog for the online patient interview. Only 1 group of students did not provide any postings. Instructor postings/comments throughout the project totaled 89. Of these, 4 were related to the project assignment and 85 were "patient" interview responses.

Discussion

The use of technology for collaboration was confirmed as being an integral part of the case study project for first-year, first-semester dental hygiene students. Blogging was the primary means of communication with case study "patients," and was utilized to enhance student knowledge of individual case assessment information. It provided an opportunity for students to formulate questions, simulating medical-dental history "patient" interviews. An additional benefit identified was the flexibility feature of mBlog. Patient interviews during clinical treatment are limited in time related to appointment scheduling. Blogging allowed students the opportunity to dialogue with the "patient" throughout the weeks of their project. This proved to be a time intensive activity for instructors, with a faculty member serving as all 8 "patients," responding to 94% of the postings. Faculty members indicated that this time was well spent and was a valuable, authentic component of the project that contributed to student success.

The organization and archivability of mBlog sites were positive features. Linking back from the case blog site to the CTools course site, where patient documentation was posted, was identified as an efficient tool. In addition to posting their own questions of the "patient," students found it insightful to review the questions of others involved with the same case. Because all postings and comments were saved, it was valuable to return to case blog sites throughout the project. Of the 10 students present in the focus group, there was a range of students from those who posted frequently (> 6) to those who had not posted at all (0). All focus group members indicated they had accessed case blog sites to read postings and comments related to patient assessment information and utilized this information to develop their group case study projects.

CTools Chat were not utilized to communicate with the "patient," as students indicated this would have involved having to schedule to be in the chat room with the "patient" at a specific time. Students felt this was an ineffective use of their time and preferred to post questions at their own convenience.

For collaboration during the organization and development of the written and oral portion of this project (treatment plan, written synopsis, and oral case presentation), neither mBlog nor CTools chat was used. First-year dental hygiene students have a credit hour intensive course load and are together an average of 35 hours per week. Students identified they most often used time between classes to meet face-to-face for project development. Familiarity and comfort level with each other also made use of the telephone another frequently used means of immediate communication and collaboration.

Students identified that even though mBlog and CTools Chat were not used among team members for project development, alternative communication technologies were used for collaboration. Email was utilized for less time-sensitive communication such as sending drafts of written material among group members. Instant messaging was identified as the most often used means of electronic discussion, as this technology utilizes the features of a chat room while allowing for ease of multitasking while working with other software applications.

Students confirmed that the group process was effective for developing the case study project. Groups found sharing the workload and professional interaction among group members to be very helpful. Having the opportunity to communicate with the case study "patient" electronically was an important factor in obtaining additional, important assessment data.

A limitation of this study is the small number of participants. Data continues to need to be collected so that the population can be expanded to a more statistically appropriate number.

Conclusion

The use of Computer Mediated Communication (CMC) is useful and effective for case study communication and collaboration in this study. However, online discourse can be affected by circumstances of student groups. Within this study, the use of mBlog for student and "patient" communication during the case study project was an effective asynchronous CMC. The use of CTools Chat was not found to be effective because of its synchronous format. Alternative CMCs (email and instant messaging) were utilized by students for collaboration during case study project development, and were used in addition to face-to-face and telephone communication. CMC has the potential to provide an effective means of communication and collaboration when the technologies align with the purpose of the project and compliment the dynamics of student groups. Further study is needed to continue to explore this effectiveness.

Acknowledgements

Notes

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Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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The Role of the Student Professional Association in Mentoring Dental Hygiene Students for the Future

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The purpose of this study was to determine the role of the Student American Dental Hygienists' Association (SADHA) in mentoring/developing dental hygiene students for the future. This project also assessed attitudes and practices of SADHA advisors towards the utilization of SADHA as a mechanism for mentoring dental hygiene students' professional development to meet the oral health needs of the public, and the goals of the ADHA. These goals include promotion of education beyond the baccalaureate level to develop qualified faculty, encouraging dental hygiene research, and promoting leadership. The study also evaluated if geographic region and academic setting impacted the utilization of SADHA.

After IRB exemption, a pilot-tested questionnaire was administered using Survey Monkey, an online survey website, to 277 individual contacts at Commission on Dental Accreditation (CODA) accredited dental hygiene programs. A response rate of 68% was achieved with 186 individual responses. Eighty percent of respondents indicated offering no mentoring opportunities outside of the curriculum, while incongruously, 58.3% felt they actively mentor through SADHA. When asked what the main focus of SADHA should be, SADHA advisors ranked community service/philanthropy as number one. SADHA chapters at institutions that offer a Bachelor of Science in Dental Hygiene (BSDH) degree completion program offer more mentoring opportunities ($p < .001$). Programs offering the BSDH offer a wider variety of topics from guest speakers ($p = .038$). SADHA chapters in Western states have a higher graduate membership conversion rate than other regions ($p = .018$).

SADHA advisors do not agree on how SADHA should be utilized. The majority of SADHA chapters are not offering mentoring opportunities outside of the traditional curriculum for leadership and career development. What is clear is that both students and advisors desire more interaction with the local ADHA components and constituents. In order to address these issues, efforts should be made to provide networking support among SADHA advisors and increase faculty perception of the importance of the professional association and the role of students in its future. The ADHA should consider developing a mentoring program that builds strong partnerships among all state constituent and components and SADHA.

Keywords: student organization, student development, mentoring, American Dental Hygienists' Association

Introduction

Professional associations can be defined as an organization or body of practitioners representing a particular profession. Foremost, the professional association sets forth criteria that must be met for a person to be considered a member of that specific profession embodied in the mission statement of the profession. The association provides support and guidance to all members. Associations serve as a unifying point for the profession by defining its role in the public, what is acceptable conduct, the values of the profession, and the present and future direction the profession wishes to take. The professional association also focuses on the individual by offering professional development of the member throughout his/her career from entry point to retirement.

Professional organizations initially take on this role by instituting formal student professional associations. Many allied health professions find themselves in the midst of radical changes and realize the importance of investing in their students while the professional organization has the students' undivided attention. Studies have been conducted to investigate the positive effect of mentoring on students' career choices.¹⁻⁹ Professional development of students is a long-term venture for the future of any profession. Instilling professional values and familiarizing the student with current professional issues through mentoring and active participation prepares students to continue participation upon graduation.

The largest national organization advocating on behalf of the dental hygienist is the American Dental Hygienists' Association (ADHA). The ADHA's stated aim is to advance dental hygiene by setting the benchmark for dental hygiene education, licensure, practice, research, and other professional issues on behalf of dental hygienists. The Student American Dental Hygienists' Association (SADHA) was created to initiate students into the profession by offering all the experiences and benefits of an active member. The purpose of this project was to determine whether SADHA is being utilized to mentor future leaders in the dental hygiene profession.

Review of the Literature

The profession of dental hygiene is currently in a unique position to take the lead in addressing the access to oral health care crisis.¹⁰ Concurrently, the dental hygiene profession is experiencing a shortage of dental hygienists with graduate education, an explosion in the number of associate and certificate programs, and subsequently, a shortage in qualified dental hygiene educators.^{11,12} This may be happening for many reasons ranging from lack of perceived opportunities to the differences in income potential between academicians and those in private dental practice. These issues are vital to the progression of the profession because if there are not sufficient numbers of dental hygienists active in the professional association and filling these needed roles, the public will turn to others who are more accessible, but do not have the expertise and education requirements that dental hygienists possess.¹³ The student professional association offers a vehicle to develop students' potential to take on these roles by exposing them to leadership and alternative career opportunities through mentoring.

In order to address these and other issues facing the profession, the ADHA in the paper report, "Dental Hygiene, Focus on Advancing the Profession" states, "The profession itself must embrace change, focus on growth and development, and plan for its future as well as the future oral health needs of the public."¹⁴ Several of the recommendations discussed in the report suggest that the educational setting is essential in accomplishing this professional growth and development. Among the recommendations, the report specifically suggests that dental hygienists pursue graduate degrees at the master's and doctoral level. Additionally, it is recommended that dental hygienists pursue research, actively recruit for leadership within the profession, and be active in legislative issues concerning dental hygiene.¹⁴ Yet, the report makes no mention of the resource of the dental hygiene students, nor the Student American Dental Hygienists' Association (SADHA), or the role of SADHA as a mechanism to influence the professional development of dental hygiene students in pursuing these career choices.

Professional Experiences Outside of the Curriculum

Past President of the American Dental Hygienists' Association (ADHA) Mary Alice Gaston asked key questions as to how students fit into addressing the issues of a dearth of dental hygienists in other aspects of the profession such as research and education. In a 2004 editorial, she raised several questions that are vital to our profession including: are programs simply funneling graduates into the entry-level dental hygiene role; are dental hygiene faculty good role models for students; and most importantly, how do we influence talented dental hygiene students to consider leadership roles and career choices beyond clinical practice?¹⁵ The importance of Gaston's questions are reflected in a national membership census survey conducted by the ADHA in 2001. This census revealed that 83% of members were employed in private clinical practice, 6% were educators, 3% were employed in corporate settings, and 1% worked in a government position.¹⁶

Students should have the chance to explore career opportunities outside of the traditional curriculum and private practice. Career opportunities such as teaching and research are often perceived as abstract concepts, making it hard for the student to picture themselves in that role. Perhaps the problem lies in student perceptions of the dental hygiene profession. Cook et al reported that understanding of students' perception of their profession is useful in developing experiences that mold students' professional identity and influence future career choices.¹⁷ Specialty tracks are an excellent example of how extracurricular experiences can shape future career choices of dental hygiene students. In 2000, Jevack reported the critical importance of positive, highly educated role models to stimulate student interest in studies beyond undergraduate level.¹⁸

Student Professional Associations

Student professional organizations can be used to lay the groundwork for future career choices and activism in the profession. Often, the value of belonging to a national professional association is not tangible, or is not conveyed to the student, making it difficult for the student to see how or why the organization is important to their career. Students must have a clear understanding of how the professional association affects their everyday lives by advocating on their behalf to prevent legislators and other decision makers from making decisions contrary to the best interest of both practitioners and their patients.¹⁹⁻²¹ Byrd et al suggested that the use of active learning experiences that signify the value of the professional association to the dental hygiene students are the most beneficial types of programs.¹⁹

Other allied health professions, such as physical therapy (PT), are currently experiencing challenges to advancing their profession as well. The transitioning of PT entry-level education to the doctoral degree can be easily compared to the development of the Advanced Dental Hygiene Practitioner (ADHP). In the quest to advance their profession, PT has recognized the importance of introducing the profession to students through the professional association. PT has experienced a, "...diminished enthusiasm and commitment among our peers for cultivating and encouraging the next generation of PTs..."²² This diminished enthusiasm had become glaringly obvious to PT students, who in response, drafted a position paper. In June of 2003, the Student Assembly of the American Physical Therapy Association (APTA) sponsored a bill in the APTA House of Delegates to, "plead for mentors inside academic and clinical settings to stress the importance of professionalism, where part of being a professional is being a member of your professional organization."²³

This brings to light the recognition that, while involved in their student professional association, students desire more than service experiences. Service is important, however, a more effective approach would be service projects that directly address guided professional development.²⁴ Opportunities for students to explore the profession outside of the standard curriculum are crucial to their professional development and future involvement. This can easily be achieved by active mentoring in the professional organization. "Participation as a student will help one make informed decisions about future educational career opportunities and provide insight into critical issues influencing the practice act and job market."²⁵ Students are able to recognize that the future of their respective profession depends upon being active in the professional association, but they are not likely to become active on their own.

Each dental hygiene program in the United States US has a professional association chapter called the Student American Dental Hygienists' Association (SADHA). SADHA could be a structured mechanism for developing dental hygiene students

for professional roles. However, the role of SADHA in each school varies widely. Therefore, the need to understand the impact the professional association is having in steering students towards advanced degrees in dental hygiene, meeting access to oral health needs, and mentoring/developing future leaders in the profession is critical.

Mentoring

Mentoring is most often referred to as a professional responsibility and as a prerequisite for recruitment and job satisfaction/retention.^{6,9,26-29} Therefore, the subject of how mentoring is meeting the challenges just discussed should be questioned. Schrubbe defines mentors as "people who can see more in you than you see in yourself."⁶ Rose et al describe mentors as those who "...pass on the traditions of the past to future generations with wisdom and justice without taking sides."²⁶ Barnes discusses the role of the mentor as someone who acts as a beacon for direction.²⁸ In general, mentoring is seen as a person or action that has such influence as to direct another's choices and affect their perspectives. How then, could a student organization serve a mentoring role?

Mentoring and its Effect on Career Selection

Few studies have been conducted to evaluate the role of mentoring in impacting students' career selection within a profession, yet the message is clear. The studies consistently show a correlation between mentoring and students choosing a career in dentistry/dental hygiene and dental education.^{1,3,5-9,27} Unfortunately, the vast majority of these studies are conducted in dental schools, not dental hygiene programs. In 2003, DeAngelis et al surveyed 142 prospective dental hygiene students as well as 80 enrolled students on their career choice and perceptions of dental hygiene. The results indicated that encouragement from dental hygienists and dentists provided the most influence on career choice.³ Similarly, Cromley and Haisch surveyed 336 matriculated dental and dental hygiene students at the Oregon Health & Science University School of Dentistry and found 52% identified that mentoring by a dentist or dental hygienist as "the most influential activity" affecting their career choice.²⁷

In 2001, Shepherd et al conducted a study of dental hygiene faculty retention. This study surveyed new, full-time dental educators of all dental schools in the US, Puerto Rico, and Canada and found: 1) mentoring is important for the retention of new faculty; and 2) without a formal mentoring program in place, a threat to successful retention of faculty will exist.⁸ Schrubbe investigated the significance and benefits of a mentoring relationship in her study and inferred that those academic institutions that are thriving have institutionalized mentoring as an integral part of their educational process by conveying the values and tenets of the profession to the mentee.⁶

These findings can be extrapolated to the bigger picture that mentoring within dental hygiene programs can be used to mold perceptions of opportunities within the dental hygiene profession and motivate students. All indications are that mentoring should be an integral part of any dental hygiene education program. What is not clear is how, or even if, SADHA is employed to mentor dental hygiene students into professional careers and association activities/leadership beyond traditional clinical practice.

Mentoring and the Student Professional Organization

No studies have been conducted on the mentoring influence of professional associations on students, but there is information on its importance. For example, the nursing profession has long recognized the importance of mentoring as a key to their professional success.^{30,19} Mentoring has been found to ease new graduates' transition into the profession from student and enhances their professional development.³¹

Finding alternative avenues to deliver mentoring is therefore imperative, as student mentorship has been shown to not only enhance personal and professional growth, but also to increase job satisfaction and retention.^{1,2, 5-9, 22, 26-28, 30,31} Nursing is well acquainted with the particular benefit of student activism, as they have realized it prepares students "...to become politically active professionals who participate in organizations that not only assist them professionally but which affect the health and well-being of the communities in which they live and serve."¹⁹ Nursing programs teach students about evidence-based research, political activism, and the role of the professional association in legislative agendas because they know these things are imperative to success in promoting their profession.^{20,29,32} These were the essential ingredients in procuring the status of nurse practitioners and assignment as Medicaid providers, as well as autonomy. This approach, particularly utilization of the professional association, has been so successful that it has become the gold standard for other allied health professions in achieving the same status. Considering these successes, the purpose of this study was to determine how SADHA is being utilized to mentor students to be future leaders, researchers, educators, or take on other roles in the dental hygiene profession.

Methods

A thirty-seven question survey (Appendix A) was designed with six domains: 1) personal demographics; 2) institutional demographics; 3) SADHA fundraising; 4) SADHA as a tool for mentoring leadership; 5) SADHA as a tool for mentoring future career development; and 6) attitudes and perceptions of SADHA Advisors. The attitudes and perceptions section offered some open-ended questions as well as Likert-scale questions.

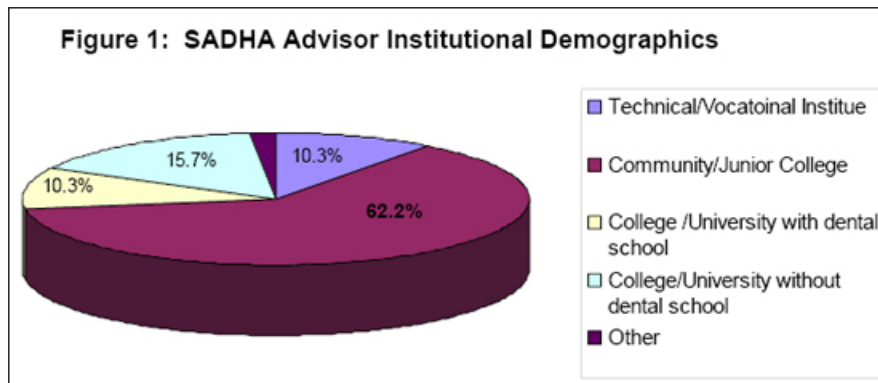
Upon IRB exemption of the study, the survey was pilot tested via an email sent to 8 dental hygiene program directors at various institutions across the US in order to enhance reliability and validity. The email contained a letter explaining the purpose of the study and requested that they forward the survey to their SADHA advisors. The email contained a link to an electronic survey engine, *Survey Monkey*, where participants could complete the survey and provide feedback. Survey participation was anonymous. Recommendations for improvement were incorporated into the survey prior to distribution.

Following the pilot, the survey was reviewed by a statistician within the Department of Statistics at the University of North Carolina Chapel Hill. Adjustments to the survey questions were made based on the pilot feedback and the statistical consultation. Program directors at 277 CODA-accredited DH programs were then contacted explaining the study and requesting the email address of their respective SADHA Advisor. The finalized survey was posted on Survey Monkey, an online survey engine, and was emailed to 277 individual contacts at CODA-accredited DH programs.

In October 2006, the survey was distributed through Survey Monkey. The survey contained a letter of consent and information relaying the importance of the survey. Participants had to select whether they voluntarily consented to participate in the survey. If a participant chose "no," they were unable to complete the survey, instead being directed to the "thank you" page. Follow-up mailings were sent twice to nonrespondents in order to ensure maximum participation in the study. A response rate of 68% (n=186) was achieved.

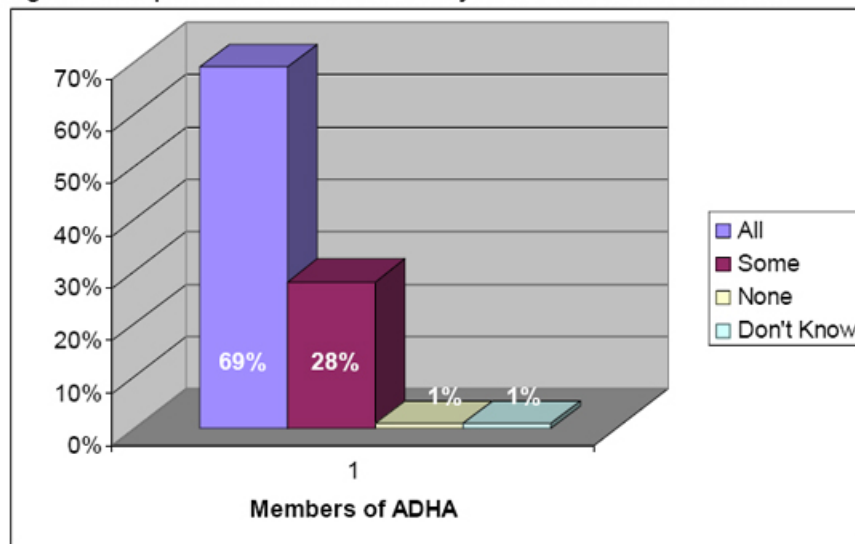
Results

A total of 186 (n=277) SADHA advisors responded to the online survey with 2 reminder emails ultimately achieving a response rate of 68%. No dental hygiene programs were excluded from participating in the survey. Figure 1 exhibits the distribution of respondents' institutional setting. Eighty-three percent offered an associates degree, while only 13.7% offered the BSDH. Sixty-two percent of respondents held a master's degree, 27% held a baccalaureate degree, 2.7% held a doctoral degree, 2.7% held an associate degree, and 5.4% held other degrees.



When asked about SADHA and membership in the professional association, 69.4% of respondents reported that all full-time faculty members at their institution are members of ADHA, while 28.4% reported only a portion of full-time faculty were ADHA members. Figure 2 presents the proportion of full-time faculty members who are members of ADHA as reported by SADHA advisors. Seventy-one point one percent of respondents indicated they were the SADHA advisor because they volunteered. Fifty-eight percent reported that SADHA membership was mandatory at their institution. DH students decided the SADHA agenda only 5.6% of the time, while a combination of the SADHA advisor and officers decided the agenda 81.6% of the time. Respondents indicated that 58.3% of SADHA chapters meet monthly, while 5.6% meet once per semester.

Figure 2: Proportion of Full-Time Faculty that are Members of ADHA



When asked about SADHA as a tool for mentoring future ADHA leadership, 13.4% indicated their SADHA chapter does not participate in any local constituent or component ADHA activities, while another 12% indicated that the local ADHA constituent and components did not participate in any SADHA activities. Figure 3 presents all ADHA constituent and component activities that respondents' SADHA chapters participate in, with a majority (64.2%) participating in community activities hosted by their local ADHA constituent or component. Figure 4 presents the local ADHA interaction with SADHA. Respondents indicated that hosting continuing education for SADHA was the primary way local ADHA contributed to SADHA activities. Forty-eight point three percent of respondents indicated their SADHA chapter participates in state dental hygiene practice legislation, while 41.4% reported that their SADHA chapter does not participate in any dental hygiene or dental health legislation.

Figure 3: SADHA Participation in ADHA Component Activities

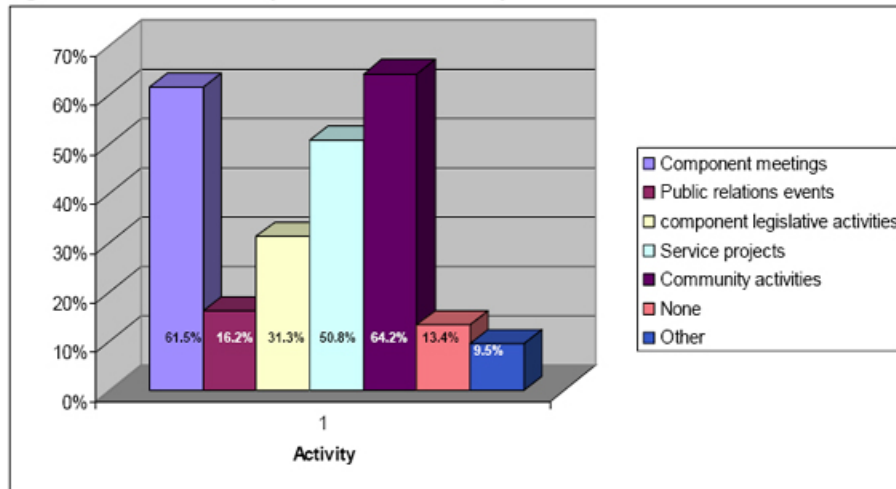
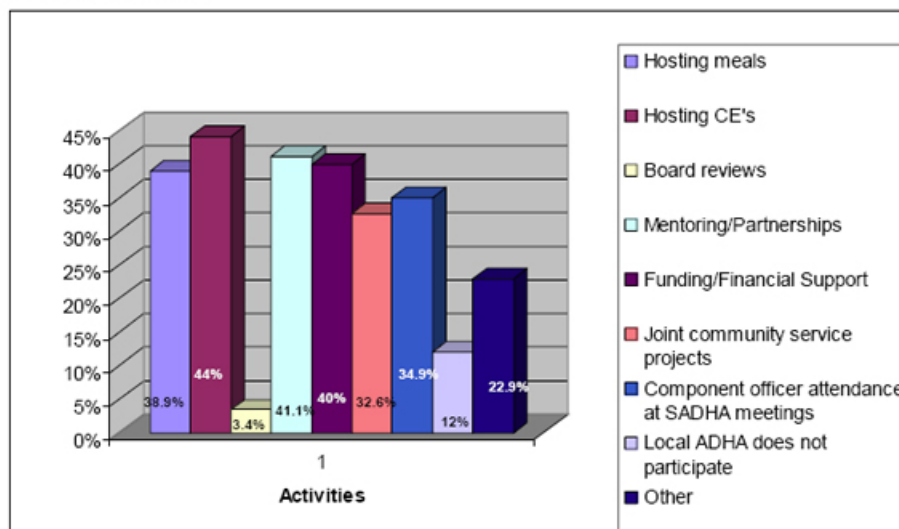
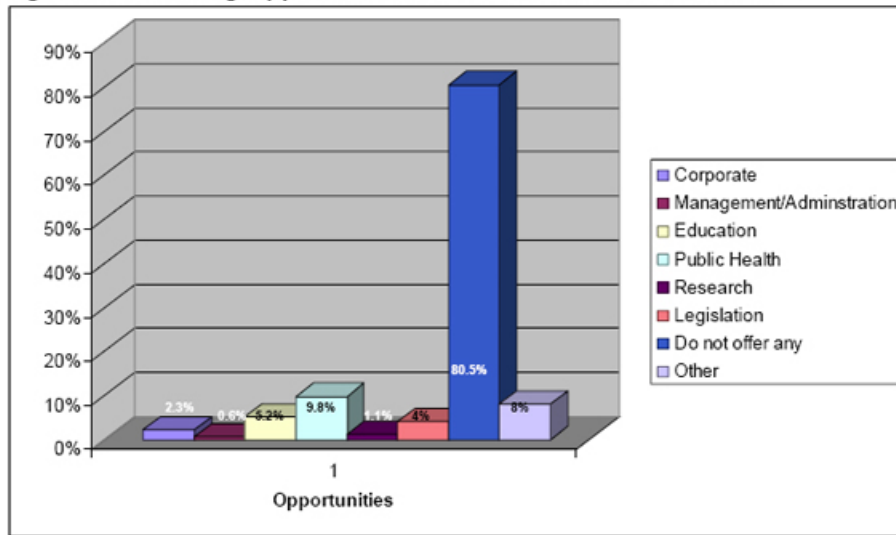


Figure 4: SADHA Advisor Reporting of ADHA Component Participation in SADHA Activities



Participants were asked to discuss the use of SADHA as a tool to mentor DH students' future career development. Sixty-five percent have guest speakers make presentations to SADHA, with 17.4% offering career fairs or shadowing, and only 2.8% offering research days. Of the guest speakers, 69% present product information, 11.9% offer presentations on graduate dental hygiene education, 22.6% degree-completion opportunities, 16.7% corporate dental hygiene opportunities, 20.8% on ADHP, and 7.7% offer presentations on research opportunities. Advisors were asked if their SADHA offered mentorship opportunities outside of the dental hygiene curriculum (Figure 5). Eighty-one percent of SADHA advisors said they offered nothing outside of their curriculum. Of those whose SADHA did offer mentorship opportunities outside of the DH curriculum, 2.3% offered corporate dental hygiene opportunities, 0.6% management/administration, 5.2% education, 9.8% public health, 1.1% research, and 8% offered other opportunities outside of those listed.

Figure 5: Mentoring Opportunities Offered Outside DH Curriculum



Advisors were also asked about their SADHA chapters' participation in national SADHA events that encourage professional development and leadership experience such as those hosted at ADHA's Annual Session. Fifty-seven percent of respondents indicated that their students sometimes apply to be student delegates, while 16.3% never have students apply. Sixty-four percent of advisors indicated that their SADHA chapter never has students participate in the student table clinics or poster session at ADHA Annual Session. Table 1 presents the frequency of SADHA participation in national SADHA events. Furthermore, when queried if they were doing any professional development/mentoring activities with their SADHA chapter that could be recommended as successful strategies to other SADHA advisors, 67.8% said no, while 32.2% offered recommendations. Almost 70% indicated they had no suggestions as to how ADHA and SADHA could be more effective in offering professional development/mentoring to the students, while 30.3% indicated they did have some suggestions.

Table 1. SADHA chapter participation in national SADHA events

Question	% Respondents			
	A	O	S	N
Do your students apply to be SADHA student delegates?	14%	12.9%	56.7%	16.3%
Does your SADHA chapter participate in the table clinics hosted at ADHA Annual Sessions?	10.7%	2.8%	22%	64.4%

A=Agree; O=Often; S=Sometimes; N=Never

The attitudes and perception portion of the survey attempted to gauge SADHA advisors' needs in their role, as well as their views on the importance of SADHA, and its role in the advancement of the profession (Table 2 and Table 3). Figure 6 presents the primary focus of SADHA as perceived by SADHA advisors. When SADHA advisors were asked to rank order what the primary focus of the student professional association should be, the number one response was community service/philanthropy. SADHA advisors were asked to indicate in rank order the population ADHA should focus on developing and nurturing professional relationships with, the number one answer was dental hygienists who are not currently members of ADHA; fostering a strong relationships with SADHA was ranked second.

Figure 6: Primary Focus of SADHA as Perceived by DH Faculty Advisors

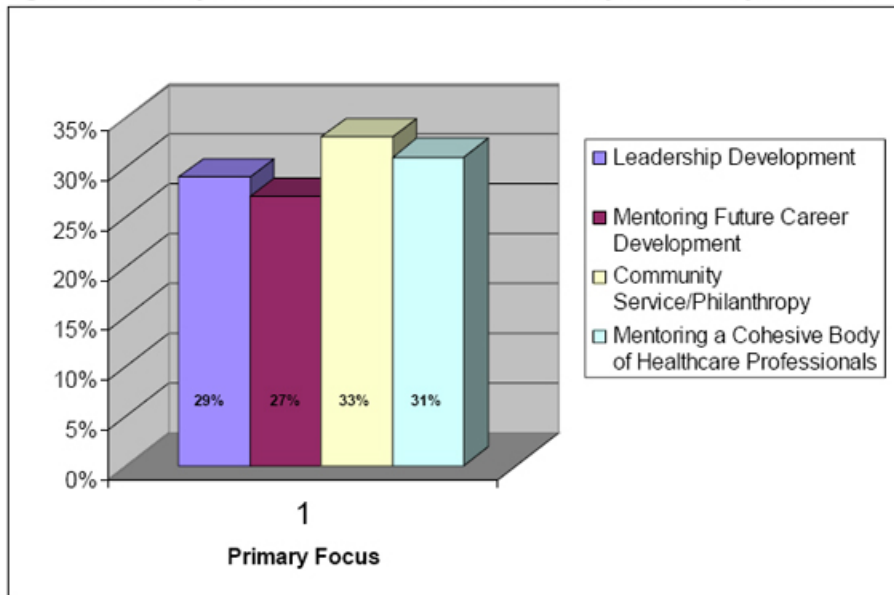


Table 2. Attitudes and Perceptions of SADHA Advisors

Likert Scale Statement	% Respondents				
	SA	A	N	D	SD
Your SADHA chapter actively mentors students' future leadership and career development.	12%	58.3%	24.6%	4.6%	0.6%
Your SADHA promotes the ADHA professional agenda.	32.8%	55.2%	9.8%	2.3%	0%
You actively consult ADHA or your constituent/component for guidance with SADHA.	8.5%	28.4%	37.5%	24.4%	1.1%
ADHA resources for SADHA are helpful.	18.1%	51.4%	21.5%	6.8%	2.3%
Methods to promote SADHA Advisor interaction and networking would be helpful.	33.1%	50.9%	13.7%	2.3%	0%

SA=Strongly agree; A=Agree; N=Neutral; D=Disagree; SD=Strongly disagree

Table 3. SADHA Advisor opinions regarding the importance of SADHA

"Students need to understand the professional nature of their chosen career if it is to become anything other than a "job".
"Foster career development-students seem to have great ideas on what direction hygiene should take."
"The future of DH is in the hands of our students."
"It is important for the students to see firsthand what it means to be a professional and how a professional association works."
"Growing future caretakers of the profession on behalf of our patients and to promote ADHA as a resource for assistance with life as a RDH."
"Cohesive professional organization, strength of professional alliance."

Bivariate analyses were performed using the chi-square and t-test to compare SADHA advisors' reported graduate conversion rates with geographic regions of the country. SADHA chapters in the Western region of the US were shown to have a higher graduate conversion rate than the rest of the country (p-value=.018).

Linear regression was used to determine potential covariates influencing SADHA professional development/mentoring activities. SADHA chapters at institutions that offer a bachelor's in dental hygiene (BSDH) degree completion program offer more mentoring opportunities (p-value=<.001). SADHA chapters housed in an institution offering the BSDH offer a wider variety of topics on career opportunities from guest speakers (p-value=.038).

Discussion

Although a response rate of 68% was achieved for this survey, there are some inherent limitations to this study that should be considered. Although no names, institutions, or other identifiers were collected or used in order to ensure anonymity of participants, it is possible that some were concerned about the confidentiality of their responses; the consequential effect being deficient acquisition of data from respondents. There is also potential for nonresponse bias. SADHA advisors who responded may be more engaged, confident, or supportive in overseeing their SADHA organization than nonrespondents. Additionally, the survey did not specifically ask about mentoring opportunities within the curriculum as the focus was on opportunities through the student organization. Therefore, although the data might accurately represent opportunities offered through SADHA, it may not accurately reflect the mentoring opportunities for leadership and career development within the offered curriculum.

This study confirmed that not all SADHA organizations in the US are being utilized as a method of developing/mentoring dental hygiene students for future roles in the profession. The reasons for this are not entirely clear, but some conclusions may be drawn. Eighty-one percent of SADHA advisors reported not offering any mentorship opportunities outside of the dental hygiene curriculum. This is similar to Blanchard's 2006 study, which reported 74.1% of dental hygiene programs stated they offered no mentoring to assist students' transition into clinical practice or other career options.³⁰ This is contradictory to the mentoring literature that consistently reports the impact, necessity, and importance of mentoring students.^{1-2,5-9,22,26-28,30,31,33}

Seventy-two percent of SADHA advisors are serving in that role because they volunteered, with 30.2% reporting that they use personal time after regular work hours at home to plan for SADHA. Utilization of the student professional organization could theoretically reduce some of the pressure from time constraints off of faculty, by offering mentoring outside of the curriculum through local members of the professional association. Respondents seem to reinforce this with statements such as: "I could use outside support to encourage students to be active participants."; "ADHA members should try to be more involved with the students/faculty."; "Foster development of the SADHA Advisor, but in a manner that allows us to participate on our own time schedule."; and "Communicate to Components the need for mentoring." These suggestions would address 2 weaknesses stated by program directors in Blanchard's study: lack of time in the dental hygiene curriculum

and inadequate support from the local dental hygiene community, and address the ADHA's charge that there must be greater networking among dental hygienists.^{14,30} These statements and the findings by Blanchard are contradictory to the 41.1% of respondents who reported their local ADHA component participates in mentoring/partnerships with their SADHA chapter. Perhaps it is a question of the type and quality of mentoring/partnerships.

The opportunities that are being offered to SADHA members are generally not activities that promote professional development or provide exposure to alternative career choices in dental hygiene. The majority of SADHA advisors reported the main option offered to SADHA members was guest speakers, but 69% of these speakers discussed product information, as opposed to other topics such as opportunities in the professional association, research opportunities, or graduate dental hygiene education. This is in direct conflict with the fact that 58.3% of respondents agreed that their SADHA chapter actively mentors students' future leadership and career development. According to the Blanchard study, "...students felt mentors provided support and encouragement outside of the academic environment."³⁰

These disparities are also quite contradictory to the recommendations put forward by the ADHA's report, "Dental Hygiene: Focus on Advancing the Profession", and show an apparent lack of recognition of SADHA as an active, integral part of the ADHA by some faculty and the ADHA state and local bodies. This paper specifically charges dental hygiene programs to promote research, advanced education, and public health/access to care among their students.¹⁴ While product knowledge is certainly important to competent, high-quality dental hygiene care, it does little to address the dental hygiene educator shortage, access to care crisis, or lack of dental hygienists with advanced degrees. This is further exemplified by the reported lack of involvement in SADHA opportunities such as participating in the student table clinics and poster sessions offered at ADHA's Annual Session. Additionally, the revelations of disparities in development/mentoring opportunities through SADHA based on the degree offered are causes for concern. All dental hygiene students, regardless of the level of degree, should receive the same benefits of SADHA opportunities.

For a mentoring program to be successful, both the mentor and the mentee must value such a program. In order for SADHA to be successful, faculty must also value the role of the professional association. Less than 70% of respondents reported all full-time dental hygiene program faculty to be members of ADHA. One SADHA advisor suggested that to effectively reach the students, the faculty must first realize the benefits of the professional association, and therefore the importance of SADHA. It appears that all SADHA advisors may not realize the value of SADHA or the role of a student professional organization. The majority of SADHA advisors believe the focus of SADHA should be community service/philanthropy. Furthermore, the majority report that dental hygienists who are not members of ADHA should be the focus population to promote the future of dental hygiene, not SADHA members. Efforts should be made to help SADHA advisors understand the true value of the student professional association and how it impacts the future of the dental hygiene profession. A mentoring program for SADHA advisors and more opportunities for them to network, perhaps through an online forum, would be helpful tools.

The onus for creating professional development and mentorship opportunities should not completely fall on the SADHA advisor, however. SADHA, as part of ADHA should have more interaction with ADHA state and local entities. Forty-one point one percent of SADHA advisors reported their local ADHA members actively sought to promote mentoring partnerships with their SADHA, yet analysis revealed these interactions seem to be more available to baccalaureate level students. Table 4 displays SADHA advisor suggestions as to how ADHA, through SADHA, could be more effective in developing/mentoring the DH student. Blanchard's study revealed that students believed that mentorship outside of the curriculum would have a positive influence as they started their careers by providing such things as concrete, rather than abstract, experiences, networking, and improved ties with the local association.³⁰ Students want to know what licensed practice will really be like, what issues they may encounter, how to handle those issues, and guidance on finding the right employment for them. The state and local components are full of potential mentors regarding these and other professional issues that students will be faced with as they make their first steps into licensed practice. Positive interaction with SADHA at the local and state level beyond component and CE courses, that offered concrete, real-life experiences, could but more value to the association for the student.

Table 4. SADHA Advisor suggestions regarding ADHA/SADHA mentoring of students

"Promote the dental hygiene profession as a team effort providing optimal care to all populations as the primary goal."
"ADHA must reach the faculty to effectively reach the students. The faculty must buy into the benefits of SADHA."
"Learn what their academic challenges are...Many are non-traditional and trying to manage studies, families, jobs, etc."
"More tools from ADHA for individual SADHA chapters; a stronger message from ADHA regarding importance of student involvement."
"More state and local dental hygiene involvement with the students...they need to come to the students, not just expect the students to come to them."
"More contact with the state and national level."

It is clear that for SADHA to recognize its full potential, several things must happen in the future. SADHA is not a separate entity from ADHA, but an active, integral component of it. It is incumbent upon ADHA constituent and local components to embrace these members and play an active role in their mentoring and professional development beyond continuing education. The students, the advisors, and the local members all have so much to offer through their different experiences and perspectives that a bright and promising future can be realized through a partnership. ADHA has recognized the importance of its role in mentoring students. Since this study was conducted, ADHA has put its plan to reach students into action by allocating monies to establish a Manager of SADHA Relations. The primary role of this position will be to assist SADHA advisors with their programs and be a contact and face of ADHA for the students and advisors.

Conclusion

The changing landscape of health care and the profession of dental hygiene's role in these changes is currently being discussed at the national level. Dental hygiene students are, and should be, viewed as the future of the profession. Many other allied health professions have long recognized the value of the student population and have directed attention and resources to foster student professional development and mentoring. Even students, such as those enrolled in physical therapy programs, have recognized the importance of mentoring to their future careers and have demanded it, not from their educational institutions, but from their professional association. In turn, these associations have recognized the future potential of mentoring through the student associations and have set up nationwide programs. These programs also boast strong membership numbers. The APTA (American Physical Therapy Association) currently has over 66 000 members and offers "Career Starter Dues" to new graduates and the "Members Mentor Members" program. The National Student Nurses Association alone boasts over 45 000 members and offers meaningful professional mentoring opportunities through programs such as "Leadership U," which offers such things as: mentoring forums where students and nursing leaders meet online, student leadership forums, a leadership library, and a faculty forum.

What is clear is that while SADHA chapters are offering opportunities to their students, the majority appear not to be leadership and career development mentoring activities outside of the traditional curriculum. Students need experience in what dental hygiene will be like for them outside of the educational setting. With lack of consensus among SADHA advisors as to how SADHA should be utilized, the development of a Best Practices in achieving student dental hygienist conversion and leadership out of school could also serve to guide SADHA activities and interactions.

No other studies have been located in the literature that address SADHA and its role in mentoring dental hygiene students, student perceptions of the professional association, or the professional association's perception of their student organization.

Therefore, further research should be done on student perceptions of the role of SADHA and the professional association in their future. Additionally, research into ADHA constituent and component attitudes and perceptions regarding SADHA should be done to get a panoramic perspective. With a full perspective, the profession of dental hygiene will better be served in its focus and direction.

Notes

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Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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Relationship of Naturally Occurring Fluoride in Carroll County, Maryland to Aquifers, Well Depths, and Fluoride Supplementation Prescribing Behaviors

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Purpose. Systemic fluorides are effective in the prevention of dental caries but over ingestion can lead to dental fluorosis. Fluoride supplements may be under-prescribed for children residing in areas where drinking water is derived from wells, because of a lack of knowledge of dental providers or the effort required to test wells for fluoride before prescribing supplements. The purpose of this study was to determine the possible factors associated with fluoride content of well water in a specific county in Maryland, and to determine whether there is a relationship between the amount of naturally occurring fluoride in the well water and the child's fluoride supplementation use.

Methods. This study analyzed the fluoride prescribing behavior and the fluoride content of wells from a sample of 197 Carroll County, Md residents. Those individuals that answered a questionnaire about well depth and use of fluoride supplements subsequently were mailed a water testing kit. Water samples were tested for fluoride using a fluoride specific ion electrode. Derivations of well water supplies (aquifers) were obtained from a county geologist. Variance in well depth and aquifer type were correlated to the levels of naturally occurring fluoride. Supplementation practices of children residing in the participating sampled households were compared to results of fluoride analyses of individual wells.

Results. Results showed that Carroll County well water contains negligible to low levels of fluoride (0.08-0.24 ppm). Pearson *r* testing showed a positive relationship between well depth and fluoride, $r = 0.23$ ($p \leq .01$). ANOVA results showed no significant difference between the 3 aquifers fluoride, $p = 0.23$. Analysis of the supplementation behavior indicated that the majority (58%) of the children that should have received fluoride supplements were receiving the incorrect dosage or not being supplemented.

Conclusion. Fluoride content of well water may be related to well depths. Fluoride supplementation practices generally were incorrect, even for this community whose wells had less than optimal fluoride content. Fluoride supplementation education may be lacking for dentists, physicians, and their patients. Future research should explore whether there is a relationship between well depth and fluoride content, as found in this study, and the variables associated with the incorrect fluoride prescribing behaviors.

Keywords: well water, fluoride, fluoride supplements, aquifers

Introduction

Topical and systemic fluorides are known to be highly effective therapeutic components of a comprehensive caries prevention plan.¹ With regard to systemic fluoride, approximately 15% of the US population receives drinking water that is regarded as fluoride deficient, ie, less than 0.6 ppm.² Fluoride supplements were developed as a way to provide caries-preventive benefits to children living in such non-fluoridated areas.³

To optimize fluoride in the drinking water, municipalities often add fluoride to community water supplies, but fluoride also may be naturally occurring in groundwater.⁴ Underground aquifers acquire fluoride compounds when minerals in rocks are dissolved through water percolation, as well as from contamination.⁵ Today's wells are being drilled deeper in order to supply enough water for household consumption, and such deeper wells require water to travel through more rock sediment before reaching the exit point. Well depth or differences in aquifers may affect the presence and amount of naturally occurring fluoride. Because of the variability of fluoride in wells it is recommended that drinking water supplies are tested before fluoride supplements are prescribed to children.⁶ However, it is believed that prescriptions are often dispensed without accounting for the possibility of naturally occurring fluoride in the child's well water.¹

The purpose of the present study was to determine the levels of naturally occurring fluoride in one county in Maryland and to relate these findings to the reported depths of the wells and to the aquifer from which the water was derived. Additionally, through a survey of the household from which the water was obtained, an analysis of the number of children who were receiving optimal fluoride, either through naturally occurring fluoride or through fluoride supplements, was calculated.

Review of the Literature

The effects of naturally occurring fluoride on dental enamel was first documented in 1901 when Frederick S. McKay, DDS, and G.V. Black, MD, observed a discoloration of enamel in their patient population; known by local inhabitants as "Colorado Brown Stain." The term "mottled enamel" was applied to this enamel defect in 1916.⁷ McKay and Black realized that mottled enamel was occurring only in certain geographic locations: individuals all consuming drinking water with fluoride levels ranging from 2-12ppm.⁸

In 1931, H. Trendley Dean, DDS, investigated the association between naturally occurring fluoride in drinking water and the prevalence and severity of mottled enamel.⁹ Dean found that at levels between 1.7-2.5 ppm, children were predominately caries-free. Dean hypothesized that an inverse relationship existed between fluoride consumption and caries prevalence. Studies by Dean in the 1940s concluded that fluoride concentrations ranging between 0.7- 1.2 ppm was optimal for caries control and prevention without producing dental fluorosis.¹⁰ Water fluoridation, beginning in 1945, reflected these conclusions.

In order to address the many children that could not consume optimally fluoridated water, fluoride dietary supplements were introduced in 1958. The Council of Dental Therapeutics of the American Dental Association published recommendations for fluoride supplementation after clinical trials in the 1940s had proven their safety.^{11,12} A literature review of 21 clinical trials on fluoride supplementation by Driscoll in 1974 found 50-80% caries reduction in the primary and permanent dentition when supplementation was started before 2 years of age.¹³

Fluoride is now contained in many foods and beverage products because they are processed with fluoridated water systems. The risk of developing enamel fluorosis is positively related to the ingestion of fluoride at above optimal levels, considering all sources such as: drinking water, prescribed supplements, dentifrices, mouthrinses, and food & beverages prepared with fluoridated water sources.¹⁴

In 1994, the Centers for Disease Control (CDC) issued a revised schedule for the recommended dosage of fluoride supplementation that reflects a dosage based on the fluoride level of an individual's water source (Table 1).¹⁵ To correctly

utilize the CDC's guidelines, drinking water must be tested for fluoride content in order to avoid inappropriately prescribing fluoride supplements.

Table 1. Fluoride supplementation levels based on fluoride ppm (parts per million) in drinking water (CDC 1994)

Age	< 0.3 ppm	0.3 - 0.6 ppm	> 0.6 ppm
Birth – 6 months	None	None	None
6 months - 3 years	0.25 mg/day	None	None
3 - 6 years	0.50 mg/day	0.25 mg/day	None
6 - 16 years	1.0 mg/day	0.50 mg/day	None

Currently, only 2 studies addressing naturally occurring fluoride levels in US well water have been identified-one in Texas and the other in the southwest region of Maryland.^{16,17} Numerous counties in Texas were found to have fluoride levels ranging from < 0.1- > 5.0 ppm.¹⁶ Southern and eastern counties in Maryland reportedly have well water fluoride levels ranging from ≤0.01- 5.0 ppm.¹⁷ To date, no study has analyzed Carroll County, Md well water for the possibility of naturally occurring fluoride.

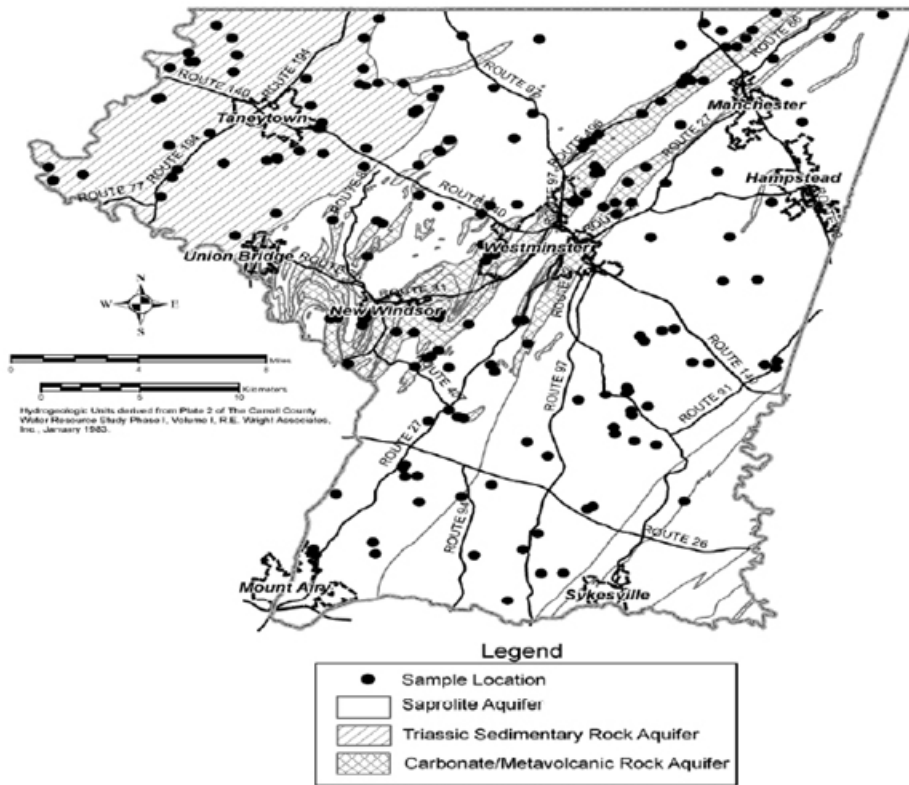
Currently, only 2 studies addressing naturally occurring fluoride levels in US well water have been identified-one in Texas and the other in the southwest region of Maryland.^{16,17} Numerous counties in Texas were found to have fluoride levels ranging from < 0.1- > 5.0 ppm.¹⁶ Southern and eastern counties in Maryland reportedly have well water fluoride levels ranging from ≤0.01- 5.0 ppm.¹⁷ To date, no study has analyzed Carroll County, Md well water for the possibility of naturally occurring fluoride. To better understand fluorosis, the National Institute of Dental Research (NIDR), between 1986-1987, conducted a study of fluorosis on 3763 children age 12-14 who were stratified into residing in nonfluoridated (0.0ppm F), sub-optimal (< 0.7 ppm F), and optimal (0.7- 1.2 ppm F) areas.¹⁸ Results revealed that the prevalence of fluorosis was highest in the nonfluoridated water groups. Prevalence could be linked to public well water systems that were naturally high in fluoride, prescribed supplements, and/or other forms of fluoride ingestion. One of the recommendations from this study was that well water should be analyzed for fluoride prior to prescribing supplementation to account for the possibility of naturally occurring fluoride.

Even though this review proved water fluoridation and the prescribing of fluoride supplements are effective at preventing caries, there is always the possibility of dental fluorosis due to inappropriately prescribed supplementation because well water was not tested for fluoride content before fluoride supplements were prescribed.

Methods

Before this study began, the Institutional Review Board of the University of Maryland School of Medicine approved the protocol. The population for this study was individual home-based wells in Carroll County, Md, selected from approximately 33 000 households.¹⁹ In order to have relatively equal sampling from the 3 aquifers, a Carroll County Environmental Health Department ground water specialist stratified the well permits into the 3 separate aquifer databases. Every "nth" well permit was randomly selected from each aquifer database until the desired sample size of approximately 200 from each aquifer was reached. The final sample consisted of 632 registered well permits (Figure 1).

Figure 1. Geographic distribution of the final sample



Selected study participants were mailed a self-administered survey (Figure 2). A cover letter provided background information and a statement of informed consent. The survey included questions regarding the age of the home, water filtration use and type, history of home fluoride testing, number and age of children living in the household, and whether any children were receiving fluoride supplementation, and if so, what was the dosage.

Figure 2: Survey



UNIVERSITY OF MARYLAND, DENTAL SCHOOL

Department of Health Promotion and Policy

Programs of Pediatric Dentistry, Dental Hygiene and Health Services Research

Information Questionnaire

Please answer all questions as they pertain to your home

1. Is your home currently on a well water system? Yes ___ No ___
If no, discontinue answering the questionnaire and return this form in the envelope provided.
2. Approximately how old is your home? _____
3. How long have you been living at this home? _____
4. Do you have water filters on your kitchen sink? Yes ___ No ___
Do you have water filters on your entire home system? Yes ___ No ___
If yes, please indicate what brand _____.
5. Has your home's well water system ever been tested for fluoride content before?
Yes ___ No ___
6. Are there children presently residing in the home, if so what are their ages?
Yes ___ No ___ Ages _____
7. Has fluoride been prescribed for children living in the home?
Yes ___ No ___
If yes, check the corresponding dosage below and indicate the child's age.
Tablet or Liquid 0.25 mg _____ 0.50 mg _____ 1.00 mg _____
8. Name and Address: _____

*Please mail questionnaire in the enclosed envelope as soon as possible. Your water testing kit will arrive shortly after receipt of this questionnaire. Thank you for participating in this study!

666 W. Baltimore St., Room 3-E-10 * Baltimore, Maryland 21201-1586 * 410 706 7970 * 410 706 3028 fax

Upon the return of a completed survey, participants were mailed a water-sampling kit. Home addresses were linked to the registered well permit number to retrieve information regarding well depths for each participating household to determine if there was a correlation between the amount of naturally occurring fluoride and the depth of the well.

The water was analyzed for fluoride content using a fluoride ion selective electrode and compared to fluoride standards of 0.1, 0.2, 0.5, and 1.0 ppm F. This is the preferred method for fluoride measurement due to its accuracy of approximately + 2 %, accounting for measurement and temperature error.²⁰ Samples measuring below 0.1 were considered negligible, and for statistical purposes, were considered as 0.08 ppm. Fluoride samples were plotted against geologic maps that designated the distribution of the aquifers in Carroll County. Pearson's r was conducted to test if well depth was related to the level of naturally occurring fluoride. Additionally, the results of the fluoride content were compared to the survey results reporting fluoride supplementation practices.

Results

Thirty-three percent, or 197 of 632, selected study participants returned a completed survey and provided a well water sample for fluoride analysis. Of the 197 samples tested for fluoride, none proved to contain biologically important amounts (≤ 3 ppm) of naturally occurring fluoride. Approximately 7% of the well water samples produced fluoride levels ranging from 0.1-0.24 ppm (Table 2).

Table 2: Measurable well water sample fluoride levels of the three aquifers.

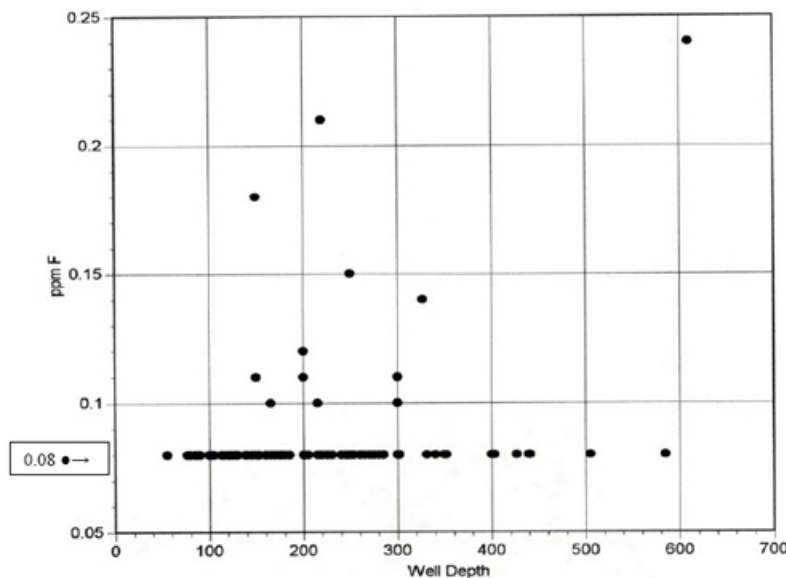
<u>Aquifer</u>	<u>Samples producing measurable results</u>	
	<u>Yes</u>	<u>No</u>
Total Carroll County	14 (7%)	183 (93%)
Carbonate	1 (1%)	69 (99%)
Saprolite	3 (4%)	70 (96%)
Triassic	10 (19%)	44 (81%)

$\chi^2 = 15.444$ $p \leq .001$

Figure 1 shows the stratified distribution of well water samples tested within the 3 aquifers. Sample distribution was spread evenly throughout each of the 3 aquifers. Analysis of Variance (ANOVA) was used to test if there were differences in fluoride concentration in the Carbonate, Saprolite, and Triassic aquifers of Carroll County. There was no significant difference in the naturally occurring fluoride levels between the 3 aquifers ($F = 1.466$, $p = 0.23$).

Wells in the study sample ranged in depth from 70 to 700 feet. There was a significant, positive relationship between the amount of naturally occurring fluoride and the depth of the wells in Carroll County, Md ($r = 0.23$, $p \leq 0.01$). As well depth increased, so did the amount of naturally occurring fluoride (Figure 3).

Figure 3: Scatter diagram of samples based on well depth and ppm fluoride



Sixty-eight of the surveyed homes noted having at least one child within recommended fluoride supplement age range (6 months-16 years), for a total of 129 children. Of the 129 children included in this study, 54 (42%) received a correct supplement dosage while 75 (58%) received an incorrect dosage based on the age of the child and supplement dosage

reported on the survey (Tables 3 and 4). Of the 75 children who reportedly received an incorrect dosage, 8 received a dosage that was too high, 20 received a dosage that was too low, and 47 were not receiving a supplement that should have been, based on the CDC's revised schedule for fluoride supplementation (Table 1).

Table 3: Carroll County supplementation practices and dosage accuracy, for individual household children.

<u>Children receiving fluoride supplements</u>	<u>Dosage Accuracy</u>	
	Correct	Incorrect
Total Carroll County	54 (42%)	75 (58%)
Yes	54 (66%)	28 (34%)
No	0 (0%)	47(100%)

$\chi^2 = 50.565$ $p \leq .001$

Table 4: Aquifers dosage accuracy, too high or too low, for homes reporting inaccurate dosages on the survey.

<u>Aquifer</u>	<u>Children receiving fluoride supplements</u>	
	Too High	Too low
Total Carroll County	11 (39%)	17 (61%)
Carbonate	1 (11%)	8 (89%)
Saprolite	5 (45%)	6 (55%)
Triassic	5 (62%)	3 (38%)

$\chi^2 = 4.978$ $p > .05$

Discussion

In the United States, approximately 60% of the population is exposed to fluoridated public water, at a cost of approximately \$0.75 per person each year.¹ Fluoridation of the public water systems from the 1940s-1960s showed a caries reduction from 50% to 70%, but studies in the 1980's found that caries reduction averaged at 26%.²¹ Fluoride ingested through drinking water is absorbed in small doses throughout a day. Frequent exposure to small amounts of fluoride on a daily basis is ideal to reduce a child's risk for dental caries, with the optimal fluoride concentration between 0.7- 1.2 ppm.²² The CDC now recommends that fluoride supplements be discretionarily prescribed to children that are considered high risk for dental caries, whose primary drinking water source has low fluoride levels.¹

To date, few studies have addressed the testing of well water for naturally occurring fluoride in the United States and no study has addressed the relationship between well depth and naturally occurring fluoride. In our present study, the relationship

between well depth and fluoride content was significant. However, it should be noted that well depth accounts for only a small percentage of the factors that influence fluoride levels in the well water. Further study of well depth and fluoride levels is required to see if such correlations are consistent in other geographic locations.

The quality of the groundwater is determined by variables affecting the underlying aquifer, such as soil characteristics, agricultural activities, and manufacturing corporations found in the region. Naturally occurring fluoride can originate from the aquifers rocks and minerals, agricultural fertilizer runoff, and many manufacturing chemicals. Since there are 3 distinct aquifer rock systems that serve Carroll County, it was hypothesized that there would be a significant difference in the amount of naturally occurring fluoride between the 3 separate aquifers. Results, however, showed that differences in aquifer type in this particular county did not have a significant affect on the amount of naturally occurring fluoride in the well water.

It also was hypothesized that if biologically significant amounts of fluoride were present in Carroll County well water, and children residing in these homes were prescribed a fluoride supplement, the resulting dosage could put them above the CDC recommended daily requirements for children considered at high risk for dental caries. The results of this study show the opposite was true; low levels of fluoride found in the well water (0.08-0.24 ppm) actually resulted in the under-prescribing of fluoride supplements for the children of this county.

Because the survey in this study found that fluoride supplements in an essentially non-fluoridated area were underutilized, a broader study may be required to determine the utilization of fluoride supplements in other communities, and whether caries risk of the children has any effect on the practices of fluoride supplementation. To better understand the lack of compliance with fluoride supplement regimens, further research should include the following questions. For those children who are taking a fluoride supplement, where is the prescription coming from? If fluoride supplements are under-prescribed, what is the reason? Was the child prescribed fluoride supplements, but is no longer taking them? How often does the child take fluoride supplements, daily or sporadically? Does the child taking, or not taking, supplements have any untreated carious lesions or restorations, and if so how many? Answers to these questions would expand the knowledge regarding fluoride supplementation and guide education reform.

The 2 major findings of this study were that fluoride content of well water may be related to well depths in a nonfluoridated community and fluoride supplementation practices were generally incorrect. Shortcomings of the present study were that there was no collection of caries risk data of the children as well as no exploration of alternative sources of fluoridated drinking water, such as school water or bottled drinks. Future studies should further explore the relationship between wells variables and fluoride levels, examine the possible effect of caries risk categorization on fluoride supplementation prescribing behaviors, and investigate other potential variables that may affect fluoride prescribing behaviors.

Dental hygienists work in collaboration with dentist employers and patients' physicians to consider fluoride prescriptions for their pediatric population. New patients are often screened for medical and dental health history by the dental hygienist. It is imperative for health care specialists to be educated with information regarding the fluoride content of each patient's drinking water before determining optimal dosage requirements. Physicians and dentists who prescribe fluoride supplements need to be aware of the level of naturally occurring fluoride in their patients' local water supplies, and educate their patient population regarding the use of fluoride supplementation as recommended by the Center for Disease Control, American Dental Association, American Academy of Pediatrics, and American Academy of Pediatric Dentistry.^{1,6,23,24} Additionally, parents need to be educated on the importance of the first dental visit by the child's first birthday so they can be informed about fluoride supplementation. Thus, all health care providers that see children need to understand the value of fluoride supplementation based on the fluoride content of their patients' drinking water, as well as each child's caries risk.

Conclusion

The present study produced data on naturally occurring fluoride in well water, well depth and fluoride levels, and fluoride supplementation practices in one community in Maryland. Results of this study show that this community's water supply contained low levels of naturally occurring fluoride (0.08-0.24 ppm). However, there was a significant positive relationship between well depth and fluoride levels. Approximately one-half of the children in this community were receiving fluoride supplementation to optimize daily fluoride exposure.

Future studies need to examine naturally occurring fluoride in groundwater in other geographic regions in the United States to determine if daily water consumption has an affect on the collective fluoride ingestion for the residents. Additionally, studies should address compliance with systemic fluoride regimens in light of community fluoride levels and caries risk of the youth population.

Acknowledgements

The authors wish to thank Dr. Harry Goodman, DMD, MPH, for assistance regarding surveys and Dr. M. Elaine Parker, RDH, PhD, facilitator of this research project.

Notes

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Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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Design and Pilot Evaluation of an Internet Spit Tobacco Cessation Program

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Purpose. To develop an interactive Web site to help smokeless tobacco (ST) users to reduce or stop their ST use and pilot test it for feasibility, acceptability, and short-term outcomes.

Methods. An interactive, multiple-contact Internet ST cessation program was developed, refined based on feedback from 17 ST users, and pilot-tested for feasibility, acceptability, and short-term effects on the ST-related behavior and attitudes among baseball athletes attending 3 colleges in California. Consenting ST users completed a baseline questionnaire and enrolled on the Web site for help with stopping ST use. One month later, outcomes were assessed.

Results. Although 18 ST-using baseball athletes enrolled on the Web site, follow-up data were obtained from 12 individuals. Loss to follow-up occurred when we were unable to contact participants by telephone or mailed surveys. At 1-month follow-up, over 80% (N=11) reported that the Web site was: "helpful in stopping or reducing my tobacco use"; easy to navigate; and "appealing." Moreover, 8% (n=1) self-reported abstinence from ST use. Among nonquitters, there was a 26% mean reduction in ST use per day compared to baseline values. In addition, among all enrollees, there was a 4-fold increase in motivation to quit (7% versus 31%) and a 21% increase in their confidence in being able to quit (67% versus. 85%) from baseline to follow-up.

Conclusion. The interactive ST cessation Web site was feasible to implement, acceptable to ST users, and appeared to reduce ST use, enhance motivation to quit, and increase confidence about one's ability to quit. Further study with a larger sample size and a control group is needed to determine efficacy to promote cessation of ST use.

Keywords: Athletes, smokeless tobacco, spit tobacco, tobacco cessation

Introduction

The adverse health effects associated with use of oral snuff and chewing tobacco, also known as spit (smokeless) tobacco (ST) include oral and pharyngeal cancer, oral leukoplakia, periodontal disease, hypertension, and nicotine addiction.^{1,2,3}

ST-associated oral health problems are visually detectable. For example, in one study, 79% of ST users had observable oral leukoplakia, a precancerous lesion, compared to 6% among non-ST users. In addition, among ST users, 85% of oral lesions were in the area where ST was placed.⁴ These oral lesions, when pointed out to users in their own mouths, appear to motivate many ST users to make a quit attempt.^{5,6} They also may serve to reinforce the benefits of cessation since the lesions often heal quickly if the user refrains from ST use for at least 2 weeks.⁷

To date, of the 10 randomized controlled trials of ST cessation treatment reported in the literature,^{5,8,9,10,11,12,13,14,15,16} 5 demonstrated that an oral cancer screening with feedback about ST-related oral problems, cessation advice, self-help materials, and brief counseling by a dental hygienist promoted ST cessation.^{5,8,9,10,11} Thus, the dental hygiene care appointment provides dental hygienists with a "teachable moment" to discuss oral health effects of ST, relate adverse oral changes to ST use, deliver a brief ST cessation intervention, and refer the client to an external ST cessation program for additional assistance with quitting. In clinical settings, tobacco cessation rates have been reported to double when 3 to 4 intervention formats are used in addition to face-to-face counseling.¹⁷ Thus, adding other formats such as a self-help quit guide and referral to a telephone quit line and/or to a tobacco cessation Web site could maximize quitting success. Estimated abstinence rates for self-help and telephone counseling range from 12% to 23% depending on the format used.¹⁹

Although smoking and ST use both involve nicotine addiction, there are several aspects of ST use that are unique from smoking that have implications in cessation efforts. For example, ST users have behavior patterns that indicate heavy dependence on nicotine such as swallowing tobacco juices and keeping a chew in the mouth all day. Also, ST users suffer far less social repercussions and may use ST without others being aware of it. For cessation efforts, this may impact issues such as social support. In addition, the lack of a standard dose, such as a cigarette, complicates efforts to use nicotine fading approaches. Moreover, ST use often is perceived as being harmless and this perception may affect a person's motivation level, or the amount of discomfort a person is willing to tolerate from nicotine withdrawal when trying to stop ST use.²⁰ Thus, quality referral resources external to the dental hygiene care appointment that are dedicated to helping ST users stop their ST use could be valuable resources for dental hygienists to use in assisting clients who use ST with the quitting process.

Review of the Literature

There are numerous studies reporting that tailored computer-based tobacco cessation programs can have significant efficacy.^{19,21,22,23} Tailored programs take into account relevant characteristics of each participant.²⁴ As computing has migrated to the Web, so have computer applications for tobacco cessation. Although Web-based smoking cessation help is widely available on the Web, only recently have studies begun to evaluate Web-based approaches to smoking cessation^{24,25,26,27,28} and even fewer studies have evaluated Web-based ST cessation programs.^{29,30} Lenert and colleagues²⁶ pilot tested online tools for self-monitoring of behaviors and computer tailored e-mail messages timed to participants quit efforts among 49 smokers. Follow-up data were obtained in 26 individuals. Among these individuals, 92% (24) made a serious quit effort, as indicated by quitting for at least 24 hours. The overall quit rate at 30+ days was 18% (n=9). An additional 16% of subjects (n=8) had a 50% or greater drop in cigarette usage, even though they had relapsed. The site, however, was reported to be unable to hold interest since enrollees returned a median of only 2 times, and, on average, completed 2 of 8 modules. Feedback from participants indicated the site was too complex. The design required users to complete a task and follow directions to perform the next activity, which required considerable attention and effort.

Woodruff and colleagues²⁷ pilot-tested a virtual chatroom among 26 high-risk youth attending 6 small, rural alternative high schools using a one-group, before-and-after design. Among the 18 youth who provided complete follow-up data, significant changes were found in the mean amount smoked per day in the past 30 days (4.4 versus 2.4, $p = 0.023$), and mean intention to quit scores (2.0 versus 2.9, $p = 0.038$). They reported that students preferred chat rooms because they were informal and convenient and involved "real time" communication.

More recently, Lenert and colleagues²⁵ evaluated whether an automated e-mail messaging system that sent individually timed educational messages increased the effectiveness of an Internet smoking cessation intervention. They compared 2 Web-based self-help style smoking cessation interventions: a single-point-in-time educational intervention and an enhanced intervention that also sent e-mails timed to participants' quit efforts. Outcomes were compared in 199 participants receiving the one-time intervention and 286 receiving the enhanced intervention with automated e-mail messaging. The 30-day intent-to-treat quit rates were higher in the enhanced group (13.6% versus 7.5%, $p = 0.035$) and appeared to increase the rate at which individuals set quit dates (97% versus 91%, $p = 0.005$) and the rate of reported 24-hour quit efforts (83% versus 54%, $p = 0.001$). They concluded that automated e-mail systems that delivered messages at strategic times are a potentially important component of Internet software systems to promote behavioral change.

Etter²⁴ compared the efficacy of 2 Internet-based, computer-tailored smoking cessation programs in a randomized controlled trial. Visitors to a French-language smoking cessation Web site were randomly assigned to either an original online, interactive smoking cessation program, or to a modified program. Both programs consisted of tailored, personalized counseling letters based on participants' characteristics followed by monthly e-mail reminders. The original program was based on psychological and addiction theory and on preliminary research conducted in the same population. The modified program was shorter and contained more information on nicotine replacement therapy and nicotine dependence, and less information on health risks and coping strategies. The baseline questionnaire was answered by a total of 11 969 current smokers (74%) and former smokers (26%) and the follow-up survey by 4237. The original program was more effective than the modified program in baseline current smokers (abstinence rates: 10.9% versus 8.9%, $P=0.003$).

To date, only one ST cessation Web-based study has been reported^{29,30} wherein an enhanced condition Web-based program (interactive, tailored program) was compared with a basic condition control Web site (static, text-based linear program) on ST cessation rates at 6 weeks, 3 months, and 6 months post-enrollment). Both Web site intervention components were based on Bandura's Social Cognitive Theory^{31,32} (described below). In addition, participants in the enhanced condition received a variety of e-mail prompts during the study for the purpose of intervention, support, or reengagement. Using intention-to-treat analysis, continuous abstinence rates at the 3 and 6 month follow-ups were 11.8% for the enhanced condition and 7.5% for the basic condition. In addition, participants in the enhanced condition made more visits and spent more time accessing their assigned Web site than did participants assigned to the basic condition Web site.

Given the limited research on Web-based ST cessation interventions, we developed an interactive Web site based on the Transtheoretical Model of Change to help ST users stop their ST use. We pilot-tested it for feasibility, acceptability, and short-term outcomes in a sample of ST-using college baseball athletes. The purpose of this paper is to report the results of that pilot evaluation.

Methods and Materials

The pilot study was approved by the Institutional Review Board (IRB) at the Committee on Human Research at the University of California, San Francisco, used one group, before-and-after design, and consisted of 2 Phases. Phase 1 involved Web site development and beta testing; Phase 2 involved pilot testing for feasibility, acceptability, and short-term outcomes among ST-using college baseball athletes.

Phase 1: Development and Beta Testing of the Web site

The Theoretical Underpinnings

The Health Belief Model³⁴ proposes that before taking action to stop ST use, a user must consider it a serious health problem, feel personally susceptible to its adverse health effects, and perceive that stopping ST use will be beneficial. Bandura's Social Learning Theory^{31,32} integrates the cognitive, behavioral, physiological, and social-environmental determinants of behavior change. Bandura's notion of self-efficacy (belief in one's own ability to quit) has proven to be a critical mediator of tobacco use behavior change and maintenance.³⁵

The Transtheoretical Model of Change³³ encompasses the Health Belief Model³⁴ and Social Learning Theory^{31,32} and defines tobacco cessation as a process, involving progress through 5 motivational and behavior change stages: precontemplation (no thought of quitting), contemplation (thinks should quit someday, but not today), preparation (has decided to quit and is taking action to modify his behavior), action (quit in less than a year), and maintenance (quit for a year or more). Self-efficacy, decisional balance variables related to the pros and cons of quitting (including health beliefs), and cognitive-behavioral self-change processes mediate progress through the stages of change. Information on our Web site addressed all 5 stages of change.

Methods

We partnered with A-Frame Software Co. (Sebastopol, Calif) to develop an interactive, multiple-contact, Internet-based ST cessation program. Once the Web site was developed, the database was loaded with simulated test data, tested for functional ability, and changes and fixes were made. We then recruited ST users to complete the Web site program and evaluate it in structured telephone interviews with study investigators. The purpose of the telephone interview was to verify that the design of the site was acceptable to the ST user community and to verify (through the use of independent, nontechnical evaluators) that the site functioned properly.

Subject recruitment for beta testing occurred by posting electronic study information on craigslist, a Web site that provides local classifieds and forums for 450 cities worldwide, and printed study information in college athletic facilities. The recruitment postings had an e-mail address as well as a toll-free number for use in obtaining more study information. Thirty-one individuals gave informed consent to participate and were given the Web site address and a password to log on to the Web site. After completing the Web site program, 17 of the 31 subjects called a 1-800 number to schedule a confidential structured telephone interview with study investigators. As incentive to participate, subjects were offered \$50 upon completion of the telephone interview. Based on feedback from these structured telephone interviews, we refined the Web site and added a Professionally Moderated Message Board and a Virtual Chat Room to provide all ST users with a community forum for peer-to-peer communication and facilitator-led communication.

The final Web site

The final revised Web site (<http://www.spitquit.org>) was operational from December 2004 to October 2006. (The static educational materials on the Web site currently are available for viewing, however, funds are being sought to continue to support the interactive components and to conduct efficacy research.) When fully functional, the Web site was an interactive, multiple-contact, Internet-based ST cessation program, and consisted of online, static, targeted motivational and educational materials, online tools for self-assessment and self-monitoring of behaviors, a professionally-monitored message board, a virtual chatroom, and generated e-mail messages tailored to the ST cessation needs of enrollees to facilitate their quit efforts. Each of the Web site components are briefly described below.

Home page

Initially, participants viewed the main home page of the Web site (Figure 1). The home page and all Web pages offered various options presented as links on a navigational bar on the left side of the page. To the right of the navigational bar on the home page, subjects clicked on the statement that best described them and were automatically linked to a Web page addressing their stage of change or readiness to quit. Clicking on the "I want to quit" link led the participant to a brief, introductory page about the pilot study of the interactive program and the general Web site. Entering the interactive components of the Web site required submission of a consent form to participate in the UCSF study. Once they submitted a consent form they received a password.

Figure 1. Home page of <http://www.spitquit.org>



Although the Web site tracked participants' completion of each module, and sent appropriate e-mails to provide reinforcement and to guide them to the next module, participants had unrestricted access to any module and were allowed to go through the modules at any pace they desired. The navigational bar also allowed users to jump from one activity to another and freely navigate the site.

Self-assessment and self-monitoring tools

After digitally signing the informed consent, and before being prompted to set a quit date, participants completed extensive online assessments of their reasons for quitting, tobacco use history, level of nicotine addiction, previous quit attempts, confidence about the impending quit attempt, concerns about quitting, personal high risk situations (ie, trigger situations when the potential for ST use is high), and patterns of use in a typical day. The latter was assessed via a digital diary. Instructions were provided on how to use the diary to monitor ST use behavior for 3 days to learn how and why one used ST. Participants recorded the time of day they used, the situation, their mood, and rated their craving on a scale of 1-10. Clicking the "Submit" button transmitted the participant's information to the computer server hosting the Spit Quit site. The information was saved to the site's internal database and then instigated the workflow process, which through a series of e-mails, responded to the specific characteristics of the ST user and guided the participant through the quitting program. For example, to build self efficacy for a successful quit attempt, ST users were asked to identify situations in which it would be most difficult to refrain from ST use once they had quit and to plan realistic strategies for coping with these situations. This was done in an effort to break down the potential overwhelming task of quitting into manageable components.

E-mail interactions with enrollees

The interactive e-mail messaging system used an automated "back office" workflow system. This "back office" system consisted of complex statistical programs (unseen by the Web site user, hence the name "back office") that used numerous algorithms to manage protocols for sending tailored e-mail messages as part of the intervention. (See Table 1 for a summary of the e-mail message protocols.) The automated "back office" system ensured that the content of the e-mail messages was tailored to individuals based on their specific characteristics as determined by replies to Web site-based assessment questions, or to previous e-mail messages. For example, the first automated e-mail message congratulated the participant on his decision to stop using ST and asked the question, "Why do you want to quit?" (See Figure 2 for the e-mail message.) Embedded in the e-mail message was an interactive link for him to click on to return to the Web site to respond to our question using a focused assessment tool (Figure 3). Once the participant submitted his reasons for quitting, the workflow program automatically generated a second e-mail thanking him for his response and reinforcing his reasons in an effort to enhance his motivation for quitting (Figure 4).

Figure 2. Text of “What made you decide to quit?” e-mail

Hi John,

Congratulations again on your decision to stop using spit tobacco.

Before we begin suggesting some quit approaches for you to use, we will need to ask you some questions about yourself and your tobacco use. Answers to these questions will be kept confidential and we will use them to tailor a quit program especially for you.

Our first question for you is: Why do you want to quit?

There are many good reasons for quitting spit tobacco (a name we use for dip/snuff or chewing tobacco). Some people quit because of health concerns, to save money, or because someone else wants them to quit. You have to determine your primary motivations for quitting. It is important to consider the health consequences of using smokeless tobacco and the health benefits of quitting to improve the likelihood of success.

Think about your most important reasons for wanting to quit using smokeless tobacco.

You should identify your reasons while your interest in quitting is high. Do it now...while you are still using smokeless tobacco and you are aware of all the problems of your addiction.

After you have been off smokeless for a while, it might be more difficult to remember the bad consequences of using smokeless tobacco. Our minds have a way of remembering good memories and forgetting the negative aspects of smokeless tobacco use. You may start to think about how good it was when you were using smokeless tobacco. If you have all of your reasons for quitting snuff or chewing tobacco written, you will be able to refresh your memory if you have a strong temptation to start using again.

Please click the following link to tell us why you decided to quit.
<http://64.142.11.47:80/wmax/HTMdocs/export/wizard.jsp?key=476a63b7f53c0e7a8361b0bf73ef080b>

Figure 3. Web site linked assessment tool for Participant to use to tell the automated workflow program why he decided to quit

Reasons for Quitting

Reasons for Quitting

What made you decide to quit?

Health
 Family
 Cost
 Spouse/Significant Other
 Taking back control

Figure 4. Text of the thanks for the reasons e-mail

Hi John,

Thank you for letting us know about your reasons for quitting spit tobacco.

Health is a great reason for quitting. As you know, dipping and chewing are associated with oral cancer, gum disease, nicotine addiction, hypertension and risk of dying from heart disease. By quitting your use of spit tobacco, you can take back control of your life and greatly reduce your risk of developing spit tobacco-associated medical problems as well as improve your well-being and quality of life.

Family is a great reason for quitting. Stopping your spit tobacco use will increase your chances of being there for your loved ones in the future and will protect your future health.

Cost is a great reason for quitting. You can save \$200.00 to \$900.00 a year or more by not buying spit tobacco.

Spouse/significant other is a great reason for quitting. Loved ones often urge quitting because they don't want anything bad to happen to you. Stopping your spit tobacco use is one way to show loved ones how much they mean to you and increases the chances that you will be there for them in the future enjoying good health with them.

Taking back control is a great reason for quitting. Spit tobacco users do become addicted to the nicotine in the tobacco. Your body becomes used to the level of nicotine and when you try to quit or cut down, irritability, impatience, anxiety, tension, poor concentration, sleep problems, changes in appetite, and craving are often experienced. Also the longer you use the more you need to use to avoid these signs of withdrawal which begin to control your life. We will work with you to develop a plan that will help you cope with nicotine withdrawal as you go through the quitting process.

Remember all the reasons you want to quit dipping and chewing in the first place. Being firmly aware of and committed to your reasons can help get you through tough situations associated with the quitting process.

Our next question for you is: What are your concerns about quitting?

Please click the following link to tell us about your concerns
<http://64.142.11.47:80/wmax/HTMdocs/export/wizard.jsp?key=476a63b7f53c0e7a8361b0bf73ef080b>

Bye for now.
UCSF SpitQuit Team

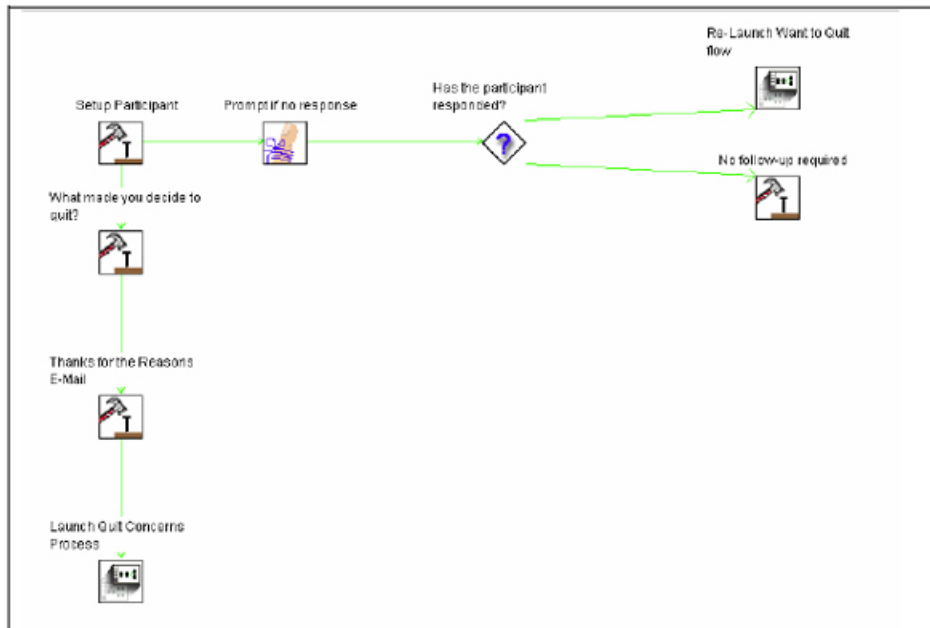
Table 1. Protocol for Sending E-mail Messages as Part of the Intervention*

Sequence of e-mail messages	E-mail Message
1st	Congratulates on the decision to stop using ST and asks "What made you decide to quit?"
2nd	Reinforces reasons for quitting and asks about concerns when thinking about quitting.
3rd	Discusses each concern and asks about history of tobacco use, etc.
4th	Provides summary of assessments and relates results to individual ST cessation needs. Asks to monitor ST use behavior for 3 days by using the Web site diary to learn how and why he uses ST.
5th	Provides feedback on the self-monitoring 3-day diary and relates the relationship of mood, environment, and dependence on nicotine to their ST use. Asks ST user to select a quit date in the next 2-3 weeks and to identify a method of getting ready to quit.
6th	Re-prompt to select a quit date and quit method if no response in 7 days
7th	Acknowledges quit date and quit method and asks to select strategies for dealing with high risk situations.
8th	Reinforces responses to high risk situations.
9th	Quit Day minus 1 day Provides encouragement and asks about coping strategies.
10th	Quit day: Congratulates and asks how it is going. Options on the Web site are: "I have quit"; "I have slipped but still am in quit mode", or "I am still using".
11th	Those who have quit are praised for their accomplishments and referred to coping strategies and information on pharmacotherapy and relapse prevention.
12th	Those who have not quit are asked to tell us where they want to go from here. Web site options are: Continue with my quit attempt without setting a new quit date; Start over – I want to set a new quit date; or, I am not ready to try to quit again.
13th	Those who respond "Continue with my quit attempt without setting a new quit date" are asked then to go back and work with the interactive Webpages on high risk situations. (This interaction will re-launch the strategies for dealing with high risk situations workflow.)
14th	Those who respond "Start over – I want to set a new quit date"; we ask them to click on the interactive link "setting a quit date." (This interaction will re-launch the workflow program to set a quit date.)
15th	Those who respond "I am not ready to try to quit again. Please do not bother me", are dropped from the program with the message "When you are ready try to quit again, we are here to help"
16th	Quit day + 1 day Repeat Steps 11-15, depending on subject response.
17th	Quit day + 3 days Repeat Steps 11-15, depending on subject response.
18th	Quit day + 5 days Repeat Steps 11-15, depending on subject response
19th	Quit day + 7 days Repeat Steps 11-15, depending on subject response
20th	Quit day + 14 days Repeat Steps 11-15, depending on subject response
21st	Quit day + 28 days Repeat Steps 11-15, depending on subject response

*All e-mail messages had embedded interactive links for the participant to return to specific Web site pages to answer questions. Submitting answers on the Web site triggered the workflow of subsequent e-mails.

Figure 5 provides the diagram of the automatic workflow process for sending the tailored e-mail message related to a participant's reasons for quitting tobacco use. Explanations of the nodes are in the legend below Figure 5. As seen in Figure 5, the "Thanks for the Reasons" e-mail also launched the next step in the workflow, the node labeled "Launch Quit Concerns Process" (see Figures 6 and 7). Figure 8 shows the automatic work flow process associated with asking participants if they have any concerns about quitting. An explanation of each node is in the legend below Figure 8.

Figure 5. A diagram of the automatic setup and reasons for quitting work flow



The node labeled “Setup Participant” represents an internal task that saves the individual participant’s information to the database and links the new workpacket to that individual. The node labeled “What made you decide to quit?” represents the interactive e-mail that is sent to the participant asking what made him decide to quit (Figure 2). The node labeled “Prompt if no response” represents an internal delay in the system that waits for 3 days for a response. After the 3 day wait, the system checks to see if the participant has responded to the question “What made you decide to quit?” This checking process is represented by the node label “Has the participant responded?”. If the participant has not responded, the system re-launches the “What made you decide to quit” process represented by the node label “Re-launch Want to Quit flow”. After another 3-day wait period, if the participant does not respond, then he is automatically dropped from the program. This process is represented by the node labeled “No follow-up required”. If the participant does respond, then the node “Thanks for the Reasons” is activated to send an e-mail and to activate the node “Launch Quit Concerns”. This latter node represents the internal task that prompts the sending of the interactive e-mail to the participant asking, “What are your concerns about quitting?”

Figure 6. Web site-linked assessment tool for participant to use to tell the automated workflow program their concerns about quitting

Concerns about Quitting
Submit my information

What are your concerns about quitting?

- Temptation to use
- Cravings
- Headaches
- Irritability
- Inability to concentrate
- Tried before but was not successful
- Weight gain
- Other - please specify:

< BACK
CANCEL
NEXT >

Figure 7. Text of the thanks for the concerns e-mail

Hi John,

Thank you for letting us know about your concerns regarding quitting.

Being tempted to use tobacco will be strongest in the places where you dipped or chewed the most. As part of developing a quit plan for you we will help you identify those situations, and what you will do instead of dip or chew to help you be prepared and to out think your habit.

Cravings and urges to use, as well as, headaches, irritability, and/or inability to concentrate are common symptoms of nicotine withdrawal. Withdrawal is your body's response when you quit using an addictive drug, such as nicotine. The withdrawal symptoms are signs that your body is cleaning out the nicotine and other chemicals. Withdrawal from nicotine can be uncomfortable, but it is temporary and ill pass. The reward will be worth it. As part of your quit plan we will suggest ways to reduce and to cope with withdrawal symptoms.

It is true that many tobacco users gain weight after quitting. A recent study found that 70% of smokers gained weight in the first month after quitting. The average weight gain reported was 5 pounds. Ten percent of smokers lose weight after quitting, and 20% stay the same. Most weight gain that occurs happens in the first few weeks after quitting. Excessive weight gain after quitting smoking is considered to be 10 pounds. It is probably the result of eating more. Exercise and being careful about what you eat is the best way to avoid gaining weight after quitting. Nicotine gum or patch may help lessen weight gain. As part of your quit plan we will suggest ways to control your weight after quitting.

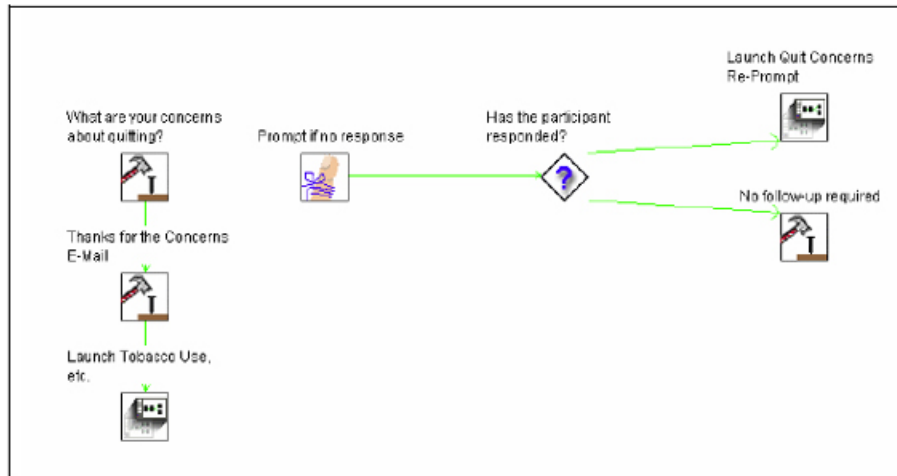
Just because you were not successful before does not mean you can never quit. It is difficult to quit, but it is possible, and you can do it. Quitting dip and chew is a process that takes most people several tries before they make it for good, and most people eventually do quit. Each time you quit, even if it is just for a few days, you learn something new about how to handle it. So the next time, you are better prepared. And remember, you cannot fail by trying.

Please click the following link to tell us about yourself and your tobacco use. This information will help us tailor a quit program just for you.

Please click the following link to tell us about your concerns
<http://64.142.11.47:80/wmax/HTMdocs/export/wizard.jsp?key=476a63b7f53c0e7a8361b0bf73ef080b>

Bye for now.
UCSF SpitQuit Team

Figure 8. A diagram of the automatic quit concerns work flow



The set up node represents an internal task that saves the individual participants information to the database and links the new workpacket to that individual. The node labeled "What are your concerns about quitting?" represents an interactive e-mail that is sent to the participant. The node labeled "prompt if no response" represents an internal delay in the system that waits for 3 days for a response. If there continues to be no response, then the system re-launches the "What are your concerns about quitting?" process represented by the node labeled "Launch Quit Concerns Re-Prompt." After another 3-day wait, if the participant does not respond, then he is automatically dropped from the program. This process is represented by the node labeled "No follow-up required." If the participant does respond, then the "Thanks for the concerns e-mail" node is launched to send an e-mail and to activate the node "Launch tobacco use, etc." This latter node represents the internal task that prompts the interactive e-mails asking the participants to continue the assessment process.

In summary, Figures 5 and 8 are just 2 examples of the automatic workflow programs built into the "back office" of the Web site to execute tailored e-mail protocols listed in Table 1. The salutation in each e-mail was dynamically generated and used the first name information entered by the participant. Submitting requested information triggered the automated back office workflow system to send a tailored e-mail message to the participant. The goal was for the recipient of the message to perceive the message content as applying only to him. The actual message was picked from a large pool of potential responses through an automated process based on specific algorithms. Message content possibilities, however, were designed by study investigators. All messages contained a uniform resource locator (URL) that was embedded in the e-mail message that brought participants back to the Web site with a click of the computer mouse.

Professionally Moderated Message Board

The purpose of the discussion board was to answer questions and offer social support. This discussion board, known as the "STOP Chew Café," was not in synchronized real time, but functioned like a bulletin board to which subjects contributed information, personal comments, and questions. Parties could carry on a dialogue with each other and the moderator with the safety of relative anonymity. The board was checked by study investigators once a day for reviewing and posting of questions and answers. Although study investigators knew who was participating, no real names were used to protect the privacy of participants.

The Virtual Chat Room

The goal of the chat room was to allow participants to interact in "real time" in an Internet-based virtual world with a trained cessation facilitator and other ST-using peers. The facilitator was to use motivational interviewing³⁶ and had the authority to eject athletes temporarily or permanently for inappropriate behavior (eg, making insulting or disrespectful remarks to other participants or the facilitator). The purpose of the chat room was to provide collaborative, participatory problem-solving between the facilitator and participants and among participants themselves.²⁷ Although study investigators

knew who would be participating, no real names were to be used to protect the privacy of participants. Office hours for the virtual chat room sessions were posted.

Static educational materials

The static online educational materials, which could be accessed at any time and downloaded, offered motivational and general information related to stopping ST use. Motivational information covered topics on the benefits of quitting and instruction in oral self-examination procedures to detect visible ST-associated problems (leukoplakia, dental erosion, and receding gums) with photos of what to look for in the mouth. The visible presence of a problem was used to enhance motivation for behavior change and the healing of the oral leukoplakia to reinforce abstinence. Enrollees were instructed that if a lesion was detected, they should stop using ST in that area. If the lesion did not disappear within 2 weeks then they should make an appointment with their dental professional to have it evaluated. If a lesion was not present, individuals were advised to quit ST use in order to avoid potential future lesions.

Other topics covered on static educational Webpages included: basic information about nicotine addiction; ingredients in ST; the importance of making a commitment; the concept of a quit date; ways to get ready to quit; thinking and action strategies to cope with not using ST (eg, repeating coping phrases such as "This urge will pass," "I can do this and I will," and modifying their behavior such as seeking the company of nonusers); the importance of social support, rewards, and oral nontobacco substitutes; withdrawal symptoms and the rationale for and use of various types of pharmacotherapy products as an aid to the quitting process; strategies to cope with temptation to use, and the importance of identifying difficult situations and planning ahead on how to deal with the urge to use ST.

Phase 2: Pilot testing the Interactive Web site

Methods

Overview

Once the Web site was refined based on feedback from beta testing, a pilot study was conducted among a sample of 18 ST-using college baseball athletes in California to evaluate the feasibility, acceptability, and short-term outcomes of the refined Web site on ST-related beliefs and behaviors. ST behavior and attitudes toward quitting were assessed at baseline and at 1-month follow-up. Descriptive summaries of follow-up data were performed to assess acceptability of the Web site and its feasibility of use. In addition, baseline and follow-up values were compared.

Recruitment and Informed Consent

From January to March 2005, we contacted the head certified athletic trainer (ATC) in a convenience sample of 3 colleges to explain the purpose, benefits and risks of the study, to answer questions, to obtain permission to recruit their baseball athletes to participate in the study, and to ask for cooperation in obtaining informed consent, administering the baseline questionnaire, and referring ST users to the study Web site for help with stopping ST use.

All 3 ATCs agreed and were mailed study consent forms, Experimental Subjects Bill of Rights (ESBR), baseline questionnaires, a prepaid, preaddressed Federal Express box for return of study documents, and a standardized training manual for obtaining and returning them to study investigators. In addition, each ATC participated in at least one telephone conversation with the UCSF study coordinator who discussed the training manual content and answered questions about study protocol. Also, each ATC was assigned a secured college log-in password to be given to referred ST users for access to the Web site.

Subsequently, the ATCs attended team meetings of male students at their colleges who had made the varsity or junior varsity baseball teams. At those team meetings, the ATC explained the purpose, benefits and risks of the study, answered questions, and provided a toll-free number of a study investigator. In addition, the ATC assured strict confidentiality, emphasized that participation was voluntary, distributed consent forms and ESBRs, obtained informed consent, and administered the baseline questionnaire to all team members who agreed to participate in the study. Attached to the questionnaire was a face page where name, current and permanent addresses, and telephone numbers were collected from each study participant. To assure confidentiality of responses, the face pages and the questionnaires were coded so that individuals did not put their names directly on the questionnaire. After completing the face page, students were instructed

to separate it from the questionnaire and place the face page in a preaddressed prepaid express mail box placed in the front of the room prior to completing the questionnaire. Further, to ensure confidentiality of questionnaire responses, an envelope was attached to each questionnaire. Students were instructed to seal their completed questionnaires in the envelope and to deposit their sealed envelopes with questionnaires in the preaddressed, prepaid shipping box provided in the front of the room. The last student to complete the questionnaire sealed the box, with the help of the ATC, so that it was ready to mail to the study investigators. The ATC then provided the team with the ST cessation Web site address and the secured college log-in password for access to the Web site.

Eligibility

To be eligible for study participation on the Web site, athletes had to: (1) report ST use within the previous 30 days; (2) be at least 18 years of age; (3) be enrolled in no other tobacco cessation program; and (4) have a California zip code. Eligible athletes agreeing to participate in the study were given the Web site address and the college password to log on to the Web site to complete another consent form and an additional baseline questionnaire; to view interactive Webpages; to receive e-mails; to participate in the virtual chat room and monitored discussion board forums (the Stop Chew Café); and to complete the online 1-month follow-up questionnaire.

Baseline questionnaire measures

The baseline questionnaire assessed the following variables to assess changes from baseline to follow-up values.

Current tobacco use status: Measured by asking the question, "During the past 30 days, on how many days did you smoke: a cigarette? Smoke a cigar?, Use chewing tobacco? Use dip/snuff? There were 7 response options ranging from "none" to "All 30 days".

Number of daps and chews per day: Answered with a number or a zero

Perceived quitting self-efficacy: Measured by asking the question, "If you decided to stop using dip or chew completely during the next 2-3 weeks, how confident are you that you can quit for good?" There were 4 response options ranging from "not at all" to "very confident."

Desire to quit: Measured by the question, "How much do you want to stop using dip/chew?" There were 3 response options: "not at all," "somewhat," and "very much."

Follow-up questionnaire measures

One-month after completion of the Web site program, a follow-up questionnaire was automatically e-mailed to study participants. After 2 weeks, a follow-up e-mail was sent to nonresponders. Two weeks later, nonresponders were contacted by telephone for completion of the follow-up questionnaire. The follow-up variables assessed were:

Gender: measured as either male or female

Ethnicity: measured with one item with 6 possible response categories: Latino/Hispanic, European American/White, Asian American, African American; American Indian/Alaska Native, Multi-ethnic

Use of pharmacologic adjuncts: Measured by asking the question, "Which of the following, if any, have you used to help you quit using dip or chew? There were 9 response options: nicotine gum, nicotine patch, nicotine nasal spray, nicotine inhaler, nicotine lozenge, Bupropion, group counseling, self-help materials, and other.

Number of daps and chews per day: Answered with a number or a zero.

Perceived quitting self-efficacy: Measure by asking the question, "If you decided to stop using dip or chew completely during the next 2-3 weeks, how confident are you that you can quit for good?" There were 4 response options ranging from "not at all" to "very confident."

Desire to quit: Measured by asking the question, "How much do you want to stop using dip/chew?" There were 3 response options: "not at all," "somewhat," and "very much".

Acceptability of the Web site: Measured with 25 items, each with 4 possible response categories ranging from "Strongly disagree" to "Strongly agree." Items addressed such topics as appeal of the technology, ease of use, satisfaction with e-mail interaction, chat room (Stop Chew Café), message board, helpfulness for quitting, and willingness to refer others to the Web site.

Feasibility of implementing the Web site: Measured by the number of subjects who visited all the components of the Web site and how helpful they found each component with 4 possible response categories ranging from "Not very helpful" to "Extremely helpful."

Abstinence from ST use in the past month: Measured by responding "None" to the question, "During the past 30 days, on how many days did you use chewing tobacco and/or dip/snuff?"

Data Analysis

Descriptive summaries of the data were performed to assess the percentage of respondents who considered various aspects of the Web-based program favorably and who reported visiting the various Web site components to assess acceptability and feasibility of use, respectively. We also evaluated the percentage of enrollees who reported continuous abstinence from ST use in the past month at follow-up. In addition, we evaluated the percentage of enrollees who reported at follow-up a reduction in number of STs per day, an increase in desire to quit, and increase in quitting self-efficacy compare to baseline values.

Results

Although 18 ST-using baseball athletes enrolled on the Web site, follow-up data were obtained from 12 individuals. Loss to follow-up occurred when we were unable to contact participants by telephone and there was no response to mailed surveys or telephone calls.

Most of the subjects were white (67.9%) (n=8) followed by Latino/Hispanic (10.7%) (n=1), African American (7.2%) (n=1), and other (14.2%) (n=2). Respondents had a generally favorable view of the site. Table 2 shows that at 1-month follow-up, 100% of the respondents (n=12) reported that they liked the site and felt like they were receiving personal attention; the Web site was very helpful to people trying to quit dip or chew use; athletes would use the site if they wanted to quit ST use; the flow of information was logical; the e-mail respondents felt like they were receiving personal attention; the monitored bulletin board with support forums was very helpful; the screen responses were consistently fast; and the graphics on the site were acceptable. No subjects, however, participated in the virtual chatroom. Thus, although it was feasible to implement, it apparently was not acceptable to the athletes.

Table 2. Acceptability: Subject Survey Responses at 1-month Follow-up (N=12)

	% agree/strongly agree	(n)
<u>Positively Worded Items</u>		
▪ I liked the e-mail responses. I felt I was receiving personal attention.	100%	(12)
▪ The flow of information was presented logically.	100%	(12)
▪ The graphics on this site were acceptable.	100%	(12)
▪ Screen response was consistently fast.	100%	(12)
▪ The Web site is very helpful to people trying to quit dip or chew.	100%	(12)
▪ I think athletes would use this site if they wanted to quit.	100%	(12)
▪ I liked this site.	100%	(12)
▪ The monitored bulletin board with support forums was very helpful.	100%	(12)
▪ The Web site was appealing and made me want to use it.	92%	(11)
▪ The Web site was helpful to me in stopping or reducing my tobacco use.	92%	(11)
▪ The Web site was easy to navigate.	92%	(11)
▪ Information provided by e-mail was useful to me.	92%	(11)
▪ Screen prompts consistently worked.	92%	(11)
▪ I found enough information to help me quit dip or chew.	83%	(10)
<u>Negatively Worded Items</u>		
▪ I would have liked more personal interaction with e-mails.	42%	(5)
▪ The pace of the e-mails was too slow.	33%	(4)
▪ More information in each e-mail would be desirable.	33%	(4)
▪ The Web site was confusing.	17%	(2)
▪ The Web site moved too slowly in providing me ways to quit.	17%	(2)
▪ The Web site was frustrating to use.	8%	(1)
▪ I felt pressured to respond to the e-mails.	0%	(0)
▪ There was not enough information on the Web site.	0%	(0)
▪ The pace of the e-mails was too quick.	0%	(0)
▪ I had difficulty finding information I needed on the Web site.	0%	(0)
▪ The screen prompts were difficult to understand.	0%	(0)

Table 3 suggests that the Web site was feasible to implement since two-thirds of the site's educational components were visited by over half of the participants (n=9). Of those who visited the various components, at least 75% (n=7) found them to be "helpful" or "very helpful" with their quit attempt. Table 4 shows that although at the 1-month follow-up only 8% (n=1) of the subjects self-reported complete abstinence from ST use, there was a 26% mean reduction in ST use per day compared to baseline values among continued ST users. In addition, among all enrollees, there was a 4-fold increase in motivation to quit (7% versus 31%) and a 21% increase in their confidence in being able to quit (67% versus 85%) from baseline to followup.

Table 3. Feasibility of Web site use: Subject use of components and reported helpfulness (N=12)

	Subjects who visited the component		Subject who visited that found it helpful/very helpful	
	%	(n)	%	(n)
Benefits of Quitting	92	(11)	91	(11)
E-mail tailored response about concerns	83	(10)	90	(11)
E-mail summary of tailored treatment suggestions	83	(10)	80	(10)
Mouth Problems	75	(9)	100	(12)
Coping with Quitting	75	(9)	78	(9)
Monitor Your Mood	67	(8)	100	(12)
Oral Cancer Self Exam	67	(8)	75	(9)
Helping Someone Quit	58	(7)	100	(12)
3-day Diary	58	(7)	86	(10)
My Social World	42	(5)	100	(12)
Maintaining Motivation	42	(5)	100	(12)
Stop Chew Café	33	(4)	100	(12)

Table 4. Comparison of baseline and follow-up behavior and attitudes (N=12)

	Baseline	1 Month Follow-up
	IN=18	IN=12
Mean number of STs per day	3.9	2.9
	%	%
Low confidence with regard to being able to quit (not at all/a little)	33	15
High desire to quit (very much)	7	31
No desire to quit	20	0
Tobacco Free	0	8

Discussion

The purpose of this pilot study was to develop and pilot test an interactive, multiple-contact Internet ST cessation program. We found that 100% of the respondents reported that they liked the Web site. In addition, at 1-month follow-up, motivation to quit had increased 4-fold, ST use per day decreased, and 8% (n=1) of the participants reported cessation of ST use. Our pilot data suggests that the Web site may have important effects on ST use behaviors, motivation to quit, and on confidence in being able to quit, although more research is needed to determine efficacy.

An effective evidenced-based Internet ST cessation program would be a useful external referral resource for clients identified in the oral health care setting who wish to stop or reduce their ST use. The strengths of a Web-based approach to ST cessation assistance would be the direct access to a high-risk population through referral from oral health care providers, and the elimination of geographic and other access barriers to treatment. The intent is to provide an effective tailored ST cessation intervention at no or very low per participant cost. Only one other study of an Internet-based ST cessation program (ChewFree.com) has been published to date and reported long term ST cessation rates of 11.8% in a sample of 1260 ST users.^{29,30} We selected college baseball athletes to evaluate our Web site because studies have documented

that many male college athletes in the United States are heavy users of ST. Findings from 2 replications of a national study of over 2000 National College Athletic Association (NCAA) athletes at 11 institutions indicate that ST is the only "social" drug out of 4 examined that has been steadily increasing in use across both sexes, all racial/ethnic groups, almost all sports, all NCAA divisions, and all geographical regions. In 2001, prevalence of ST use in the past 30 days reported among male NCAA athletes playing baseball, football, golf, ice hockey, lacrosse, soccer, water polo, and wrestling, ranged from 20% to 40%.³⁷

In 2000, The Public Health Service published an updated Clinical Guideline for the Treatment of Tobacco Use and Dependence¹⁸ in clinical settings. The overarching theme of this Guideline was that healthcare providers should apply the "5-A's Approach" to treatment of tobacco use and dependence in clinical health care settings. The 5-A's Approach is: Ask all clients if they use any form of tobacco; Advise all tobacco users to quit; Assess for willingness to quit; Assist with the quitting process appropriately based on willingness to quit; and Arrange follow-up. Dental hygienists as oral health educators and prevention specialists are well-positioned to apply this 5-A's Approach, especially since they often see clients for multiple appointments per year. Nevertheless, evidence-based referral resources for ST use cessation assistance to augment dental Hygienists' brief counseling are limited. Telephone quit lines provide quality external resources for referral, but not all clients like to talk over the telephone.³⁸ Moreover, it is unclear how effective they are in promoting cessation among ST users who are unique from smokers. An interactive Web site has the potential to reach a large number of college baseball athletes who use ST and to reach other ST users especially if there was an oral health care provider- and athletic-trainer-based referral strategy in place.

The use of online tools for self-monitoring of behaviors and computer-generated e-mail messages tailored to the ST cessation needs of enrollees may have great potential for improving the quality of intervention offered by static Web sites that offer only educational information. Our Web site used workflow programs to prompt participants to follow customized protocols, made branching decisions based on enrollee responses to prompts, and eliminated delays in administration tasks. An important design aspect of the Web site is the spontaneity it allows for skipping from one part of the Web site to another. This approach overcomes the rigid "procedural" style that has been reported to have hampered Web sites dedicated to smoking cessation.²⁶

Surprisingly, however, athletes participating in this study did not participate in any of the virtual chatrooms offered. This finding is inconsistent with reports in the literature that suggest that teens²⁷ and college students³⁹ prefer chat rooms because they are informal and allow participants to interact in "real time" with a trained cessation facilitator and other tobacco-using peers.

When asked about the acceptability of the chat room option, however, several of our subjects mentioned that the scheduled times often competed with other commitments and/or they became distracted with other things and forgot about the chat room availability. Based on our pilot results and the cost associated with personnel to facilitate the chat room experience, we decided to eliminate this component of the Web site.

Several limitations of the present study, however, must be considered when interpreting the present data. First, this study involved a small convenience sample of ST users rather than a large random sample. The small sample size and lack of a control group dictated limited data analysis. Thus, one cannot generalize the results of this pilot study to other ST users.

Another study limitation is that the self-reported ST use in this pilot study was not verified by biochemical assay and may be subject to under- or over-reporting. As anti-tobacco use norms become more pervasive in society, especially in California given its comprehensive tobacco control program, respondents may have been reluctant to admit to continued regular tobacco use. Nevertheless, although it is ideal to validate self-reported smoking status, biochemical validation over the Internet is not feasible.

Finally, our findings are limited by the fact that our study was conducted among college baseball athletes who are at higher risk for ST use compared with the general population. Thus, our results may not apply to the general population of ST users. We chose to work with college baseball athletes due to the high prevalence of ST use reported in this population to maximize exposure of our Web site to as many ST users as possible given limited time and resources. We were surprised, however, to find that the chat rooms scheduled on our Web site were unproductive.

Conclusion

The interactive Web site evaluated in this pilot study was feasible to implement, acceptable to ST users, and promising with regard to promoting cessation of ST use. Further study with a larger sample size and a control group is needed to demonstrate the Web site's efficacy to promote ST cessation. The dental hygiene care appointment provides a unique opportunity to deliver brief ST cessation assistance and then to refer ST-using clients to evidence-based external resources to augment their assistance provided at chairside with ST cessation.

Acknowledgements

Funding for this study was obtained from a grant from the Tobacco-Related Disease Research Program of the State of California. We also would like to thank Joanna Hill for valuable technical and administrative assistance.

Notes

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Source: Journal of Dental Hygiene, Vol. 82, No. 1, January 2008

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Mothers'/Guardians' Knowledge about Promoting Children's Oral Health

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Purpose. *The purpose of this study was (a) to explore what mothers know about promoting good oral health in their children and which information they need, and (b) to identify whether factors such as age, years of education, and number of children in the family affect their knowledge.*

Methods. *Data were collected from 105 mothers/guardians (age range: 19 to 54 years) who brought a child to an appointment at a community dental clinic. When provided with a choice, 54 mothers/guardians responded to surveys, and 61 participants asked to be interviewed. The respondents had between 1 and 9 children (mean=2.48).*

Results. *Only 25.7% of the respondents gave correct answers to a question concerning the age at which children should start seeing a dentist, and only 32.4% correctly answered a question about the age at which their children should have their teeth brushed. However, the majority of mothers (91.4%) knew that a child should not go to bed sucking on a bottle containing milk or juice. The higher the family income was, the more the respondents knew about dental care utilization and oral health-related behavior. The more years of education the respondents had, the more they knew about the consequences of poor oral health. The more children the mothers had, the more they knew about preventing oral health problems. The more knowledgeable the respondents were about oral health promotion, the more often they brushed and flossed, and the less dental anxiety they had.*

Conclusions. *Parents and caregivers can play an important role in preventing oral disease in children and should thus be well educated about oral health promotion. These findings point to the importance of focusing educational efforts on educating younger mothers with fewer children and/or less education who come from socioeconomically disadvantaged backgrounds.*

Keywords: oral health promotion, children, mothers' knowledge, prevention, oral health

Introduction

Young children are very susceptible to oral diseases, which could be prevented if their caregivers were sufficiently informed about their causes and treatments and were motivated to engage in appropriate oral health promotion. A prime example of a preventable disease among children is Early Childhood Caries (ECC), a severe form of tooth decay that affects the

primary teeth of infants and young children up to 71 months of age.^{1,2} Some children have carious lesions even before they are able to develop good oral hygiene habits.³ Research has shown that mothers or other primary caregivers are typically responsible for teaching their children proper hygiene skills.³ Since caries is a preventable disease, primary caregivers play a crucial role in preventing dental caries in young children. Therefore, it is crucial that caregivers are educated early on about the prevention and treatment of dental caries.⁴ Research has shown that mothers' dental awareness has an important impact on their children's oral health and oral health-related behavior.⁵

The first objective of this study was to explore what mothers/guardians know about promoting their children's oral health in order to determine what information they need. Gaining a better understanding of the knowledge mothers/guardians have about oral health promotion can help dental care providers address the topics that should be targeted when educating parents and other caregivers about how to prevent oral disease in their children. The second objective focused on identifying who should be targeted for educational interventions. Consequently, this study also explored if any background factors such as the mothers' age, number of children, education, and income, as well as oral health-related factors, such as dental fear and the history of oral health care experiences, affected their knowledge about promoting their children's oral health. Identifying who knows what would allow dental care providers to provide the most needed information and then target educational efforts in such a way that they reach the specifically vulnerable groups of caregivers most in need for this information.

Review of the Literature

Caries in children is the most common chronic childhood disease. It is 5 times more common than asthma, 7 times more common than hay fever, and 14 times more common than chronic bronchitis.² In one study, only 231 out of 446 preschool children were completely caries-free.⁶ Early childhood caries, a severe form of tooth decay that affects the primary teeth of infants and young children up to 71 months of age,² can have serious consequences for a child's general health,⁸ future oral health,⁹⁻¹¹ and quality of life.¹²

Early Childhood Caries can be prevented by successfully educating primary caregivers of newborn children about this disease and by thus motivating them to engage in positive oral health promotion efforts. Research suggests that many mothers do not know how to prevent caries in their children. In 1998, Hood identified that 26.7% of mothers of children 5 years and under who brought their children for extractions of teeth under general anesthesia to a dental school did not know how to prevent caries in their children.¹³ This finding is important because an analysis of insurance claims data on 9886 children showed that primary posterior tooth treatment in this age group was associated with future permanent first molar treatment.¹⁴ Ismail concluded In a review of the literature on prevention of Early Childhood Caries, Ismail concluded that in addition to offering preventive dental services such as fluoride varnish, the education of mothers and caregivers should be promoted, especially in high risk communities and population groups such as low-income families and native populations, because mothers' behavior influenced their children's oral health status.³

High sugar intake is a significant factor in dental caries.¹⁵ Putting an infant to bed with a formula bottle or a sucking cup with juice, or giving children sweets as snacks, are topics that dental care providers need to discuss with caregivers.¹⁶ Chestnut et al indicated that many mothers knew that putting children to bed with a bottle containing a sugary liquid was harmful. However, because they did not understand why it was harmful, they continued to give sugary drinks at night.¹⁷ Blinkhorn illustrated that 100 out of 139 mothers admitted giving their children sweets to reward them for good behavior, to pacify the child, or for no specific reason.¹⁸

Kay and Locker suggested that an understanding of what mothers know about oral health issues is crucial in order to modify their behavior and encourage good health promotion.¹⁹ Hale stated that along with proper feeding practices, mothers should also be aware of the timing of basic oral health practices, such as when a child should see the dentist for the first time, and when a child should have exposure to small amounts of fluoride.²⁰ Knowledge about toothbrushing is crucial

as well. A study by Wierzbicka et al concerning the prevention of caries demonstrated that 80% of the respondents answered that toothbrushing can prevent dental decay. However, only 46% of these respondents believed that fluoride could prevent decay. Few mothers mentioned flossing when asked about oral hygiene practice in their households.²¹

Research also showed that the degree to which mothers understand oral health issues is significantly related to better oral health in their children.⁸ In addition, mothers' knowledge about oral health had an important impact on their children's future oral health-related practices.⁵ Gaining a better understanding of what mothers and other primary caregivers know, and what they do not know about optimal oral health promotion for children, would be the first step to develop educational materials about oral health-related matters to better educate caregivers.

While all mothers should be educated about how to prevent disease and promote good oral health for their children, there might be specific groups of mothers that need more education about these issues than other mothers. It is therefore important to explore which mothers should be especially targeted for educational interventions. A mother's socioeconomic background may be a contributing factor to oral health concerns. Research has shown that caries is especially prevalent in children who come from disadvantaged backgrounds.²²⁻²⁴ This finding may be related to the lack of available health care. However, it could also be related to a lack of knowledge about the causes of dental disease and oral health practices. In addition, Rajab and Hamdan showed that a low level of education was associated with a lack of information about oral health issues and lack of access to dental care.²⁵

Additional factors to consider when exploring influences on children's dental health could be the age of the mother or primary care giver and the number of children for which care is being provided. Comparisons of these groups could address the question whether young and/or first-time mothers have less understanding of concerns related to oral health issues than older mothers and/or mothers with more than one child.

In addition to exploring the role of background factors, oral health-related variables could be of importance as well. Mothers' own oral health practices and their dental fear might also affect the way they approach oral health promotion in their children. Rossow showed that mothers who flossed regularly were more likely to have children who flossed.²⁶ While flossing is very important for removing inter proximal debris, one study found that only 13% of 622 adults flossed daily, and 52% admitted to never flossing.²⁷ Dental fear was shown by Segelnick to cause mothers to avoid visiting a dentist.²⁷ Arnup et al found that a mother's dental anxiety can be passed on to their children and impact their dental treatment.²⁸

In order to prevent oral disease in children, primary caregivers (mothers and guardians) have to be educated about how to promote good oral health in their children. Dental care providers need to know what topics concerning oral health promotion they should cover and who should be targeted for special educational efforts.

Methods and Materials

Design

This research was a survey study designed to explore mothers'/guardians' knowledge about how to promote their children's oral health. The research was conducted at the Pediatric Dental Clinic at Mott Children Health Center (CHC), in Flint, Genesee County, Michigan, between June 22, 2005, and July 20, 2005. The Pediatric Dental Clinic at Mott CHC serves children of Genesee County who come from socioeconomically disadvantaged backgrounds (200% under the poverty level). This research was approved by the Institutional Review Board (IRB) for the Health Sciences at the University of Michigan, Ann Arbor, MI., and by the IRB of Mott Children's Health Center.

Respondents

Data were collected from 105 mothers/female guardians. The respondents were on average 29.96 years old (range: 19 to 54; SD=7.343). They had on average 13.40 years of education (range= 8 to 19 years; SD=2.06).

Procedure

The mothers/guardians of regularly scheduled pediatric dental patients at this community dental clinic were invited to participate in this study upon arrival at the dental clinic. They were informed that they would receive one soft ADA-approved toothbrush and a trial size tube of toothpaste as a gift for their participation. Once the mothers/guardians read the consent script and orally consented to participate in the study, they were given a choice to either respond to a written survey on their own, or participate in a face-to-face interview. Sixty-one respondents choose to be interviewed and 54 respondents completed the written survey. All interviews were conducted by one female interviewer who had been carefully trained to avoid leading questions and to use the exact wording of the questions. This interviewer also administered the survey to the participants who chose to respond to the survey. All respondents were fluent in English. The data collection was conducted in 1 of 2 waiting rooms, or in a private room while the respondents' children received dental treatment. The mothers were given the choice to skip any questions they did not want to answer. No names or other identifying information were collected.

Survey

The survey consisted of 3 sets of questions that the researchers developed. The first part had questions concerning the respondents' demographic background, such as their age, education, income, and number of children. The second part consisted of oral health-related questions such as questions concerning the mothers'/guardians' and children's health behavior and dental history, and included the Dental Anxiety Scale - Revised to measure the respondents' level of dental anxiety. The third part consisted of 20 knowledge questions. Each question consisted of a statement concerning children's oral health-related topics for which the respondents' had to indicate whether it was correct or false (see Table 1). The 20 statements addressed 4 issues. The first topic was concerned with children's oral health-related behavior such as brushing ("When a child is about two years old, mothers should start to brush their teeth"; "Once children are 6 years old, they can brush their teeth without supervision"; "Older children should brush their teeth twice a day"), flossing ("Children should have their teeth flossed by 3 years of age"; "Children should floss their own teeth once they are 6 years old"), or the use of tooth paste and toothbrushes. The second set of questions was concerned with utilizing health care services. This category had 2 questions: ("Once a child is two years old, the child should visit the dentist"; "Children should see a dentist twice a year"). The third category consisted of 4 questions assessing knowledge concerning the prevention of oral disease and caries ("Cavities are the most common chronic childhood disease in children under 7 years of age"; "Water fluoridation is important to prevent cavities"; "A child should not go to bed sucking on a bottle containing milk, formula, or juice"; "Sucking on pacifiers is not bad for a child's teeth"). The final category consisted of 5 items about the consequences of oral disease ("A child with severe cavities is likely to not gain weight appropriately"; "Poor dental health could affect a child's general health"; "Poor dental health can affect a child's ability to learn"; "Dental pain can keep a child from paying attention in class"; "Poor dental health can keep a child from sleeping through the night"). The 20 statements were randomly presented and not grouped by topic.

Table 1: Percentages of mothers who responded correctly to the knowledge questions asked

	Correct Answer	Rank*
Oral Health-Related Behavior:		
Before a baby has a first tooth, mothers should clean their gums with a cloth. (True)	83.3%	8
When a child is about two years old, mothers should start to brush their teeth. (False)	32.4%	18
Once children are about 6 years old, they can brush their teeth without supervision. (True)	48.6%	15
Older children should brush their teeth twice a day. (True)	70.5%	11
Children should have their teeth flossed by 3 yrs of age. (True)	56.2%	14
Children should floss their own teeth once they are 6 years old. (False)	44.8%	16
A pea size amount of toothpaste is all that is needed to brush a child's teeth. (True)	87.6%	4
A child should not swallow toothpaste. (True)	86.7%	7
A child's toothbrush should be replaced every 6 months. (False)	21%	20
Utilizing Health Care Services:		
Once a child is two years old, they should visit a dentist. (False)	25.7%	19
Children should see a dentist twice a year. (True)	90.5%	3
Knowledge / Prevention of Disease:		
Cavities are the most common chronic childhood disease in children under 7 years of age. (True)	68.6%	12
Water fluoridation is important to prevent cavities. (True)	81%	9
A child should not go to bed sucking on a bottle containing milk, formula, or juice. (True)	91.4%	2
Sucking on pacifiers is not bad for a child's teeth. (False)	73.3%	10
Consequences of Poor Oral Health:		
A child with severe cavities is likely to not gain weight appropriately. (True)	42.9%	17
Poor dental health can affect a child's general health. (True)	87.6%	4
Poor dental health can affect a child's ability to learn. (True)	58.1%	13
Dental pain can keep a child from paying attention in class. (True)	91.4%	1
Poor dental health can keep a child from sleeping through the night. (True)	87.6%	4

Legend: * The ranking of the percentages of correct answers starts with 1 = most frequent correct answer.

Pretest

A pretest of the survey was conducted with 42 dentists, dental hygienists, dental assistants, and administrative staff persons from a community pediatric dental clinic. A free lunch was provided for these staff respondents and they were then asked to give feedback to the survey. Any suggested changes were considered and included in the final version of the survey.

Statistical analyses

Descriptive statistics, as illustrated in Table 1, were used to summarize the frequency of correct responses. Correlations were used to identify associations between the respondents' knowledge, measured as the sums of correct answers in each of the 4 categories of knowledge questions, with the respondent background factors and oral health-related indicators. This is illustrated in Table 2. Finally, independent sample t-tests were conducted to test whether the average number of correct answers in the 4 groups of knowledge questions differed for younger (up to 23 years of age) versus older mothers

(23 years or older); mothers with lower versus higher income (< \$1000 vs. \$1000 and more monthly income); and mothers of fewer children (pregnant or mothers with 1 or 2 children) versus mothers with more children (3 or more children).

Table 2: Correlations between the background factors and the dental health-related factors and the four indices of health-related knowledge

	Health Behavior - Sum Score	Dental Visit - Sum Score	Prevention - Sum Score	Consequences - Sum Score
Demographic Factors:				
Age	-.159	-.005	.160	.163
Income (4 categories)	.185 (p=.080)	.239 (p=.017)	-.027	.054
Years of Education	.090	-.134	.017	.193 (p=.067)
# of children	.078	.135	.195 (p=.055)	.065
Health-related Factors:				
Dental Health	.135	.024	-.113	-.184 (p=.071)
Frequency of Brushing	.278 (p=.008)	-.004	-.023	.155
Frequency of Flossing	.231 (p=.028)	.082	.054	-.031
Number of Fillings	-.039	.022	-.033	.225 (p=.049)
Dental Anxiety Score	-.201 (p=.060)	-.046	-.087	.124

Results

The first aim of this study was to explore what the respondents know about promoting their children's oral health. As can be seen in Table 1, the percentages of correct answers for the 20 questions ranged from a low percentage of 21% for the statement "A child's toothbrush should be replaced every six months" to the highest percentage of 91.4% correct answers to the questions "A child should not go to bed sucking on a bottle containing milk, formula, or juice" and "Dental pain can keep a child from paying attention in class." It is interesting to note that the percentage of correct answers concerning the age at which a child should start utilizing healthcare services was low (25.7%), as well as the percentage of correct answers concerning when a mother should start brushing a child's teeth (32.4%). Overall, these results indicate what specific information should be provided for mothers in educational interventions concerning promoting good oral health in children.

The second aim was concerned with gaining a better understanding of which groups of mothers/guardians should be primarily targeted for receiving information about each of the 4 topics, namely information about oral health behavior, utilization of dental health care services, prevention of oral disease, and the consequences of poor oral health. The role of sociodemographic factors and oral health-related factors were investigated in these analyses.

Knowledge concerning health behavior

The results concerning the question of which mothers/guardians should be educated about oral health-related behavior such as brushing and flossing showed that the respondents' income, their own health behaviors ("Frequency of brushing"; "Frequency of flossing"), and their dental anxiety were relevant factors to be considered. As can be seen in Table 2, these factors had at least a tendency to be correlated with the sum of correct answers to the knowledge questions about health behavior. The more frequently the respondents brushed their teeth and flossed, the more knowledgeable they were about children's oral health behavior (brushing: $r=.278$; $p=.008$; flossing: $r=.231$; $p=.028$). There was a tendency towards significance for the correlation coefficients between the respondents' average dental anxiety score and their health behavior

knowledge score ($r=-.201$; $p=.060$), and their income and this knowledge score ($r=.185$; $p=.08$). A stepwise regression analysis showed that the average dental anxiety score was a significant predictor of this knowledge index concerning health behavior (standardized beta coefficient = $-.303$; $p=.013$). In summary, the more diligently the respondents engaged in brushing and flossing their own teeth, the more likely they were to know about promoting these behaviors correctly in their children. However, the more dental fear they had, the more they needed information about brushing and flossing their children's teeth.

Knowledge concerning dental care utilization

The next questions addressed in the analyses focused on which mothers/guardians should be educated about dental care utilization issues. The results showed that the "dental visit" index was significantly correlated with the respondents' income ($r=.239$; $p=.017$; see Table 2). The more income the respondents had, the more they knew about oral health care utilization. The stepwise regression analysis confirmed this finding. It showed that the dependent variable "Knowledge concerning dental care utilization" was significantly predicted by family income (standardized beta coefficient = $.349$; $p=.003$). As can be seen in Table 3, respondents with a monthly income of under \$1000 knew on average 1.04 of the 2 questions, while respondents with more than \$1000 monthly income knew on average 1.30 of the 2 questions ($p=.017$).

Table 3: Average number of correct answers of mothers / guardians categorized by age, income, and number of children

	Up to 23 years	= >23 years	p
Oral Health-Related Behavior (9 items):	5.00	5.42	n.s.
Utilizing Health Care Services (2 items):	1.17	1.19	n.s.
Knowledge / Prevention of Disease (4 items):	2.55	3.28	.007
Consequences of Poor Oral Health (5 items):	2.83	3.88	.008
	Income <	Income >	
Oral Health-Related Behavior (9 items):	5.14	5.56	.083
Utilizing Health Care Services (2 items):	1.04	1.30	.017
Knowledge / Prevention of Disease (4 items):	3.20	3.22	n.s.
Consequences of Poor Oral Health (5 items):	3.67	3.83	n.s.
	0, 1 or 2 children	3 or more children	
Oral Health-Related Behavior (9 items):	5.36	5.37	n.s.
Utilizing Health Care Services (2 items):	1.15	1.23	n.s.
Knowledge / Prevention of Disease (4 items):	3.02	3.35	.058
Consequences of Poor Oral Health (5 items):	3.66	3.84	n.s.

Knowledge concerning the prevention of oral disease

Concerning which mothers/guardians should be educated about the prevention of oral disease, the number of children in a family should be considered. There was a tendency for significance of the correlation between the knowledge index regarding the prevention of oral disease and the number of children in a family ($r=.195$; $p=.055$; see Table 2). As can be seen in Table 3, pregnant mothers without a child, and mothers of 1 or 2 children knew on average 3.02 of the 4 questions, while mothers of 3 or more children knew on average 3.35 of the 4 questions ($p=.058$). In addition, Table 3 showed that respondents under the age of 23 years gave on average 2.55 correct answers, while mothers over 22 years gave on average 3.28 correct answers concerning the knowledge about preventing oral disease ($p=.007$). In summary, pregnant mothers and mothers of 1 or 2 children, as well as very young mothers (under the age of 23 years), should be especially targeted to receive education about how to prevent oral disease in their children.

Knowledge concerning the consequences of poor oral health

Concerning the question which mothers/guardians should be educated about the consequences of oral disease, it was found that this knowledge index was significantly correlated with the respondents' own experiences with poor oral health, specifically with the number of fillings the respondents had ($r=.225$; $p=.049$). Not surprisingly, the more fillings the respondents had, the more they knew about the consequences of having poor oral health. In addition, some correlations

between this knowledge score and the respondents' perceived dental health score ($r = -.184$; $p = .071$), and years of education ($r = .193$; $p = .067$), showed a tendency towards significance. In addition, a regression analysis showed that the frequency of tooth brushing was a significant predictor of this knowledge index (standardized beta coefficient = $.333$; $p = .041$). As can be seen in Table 3, mothers under 23 years of age had on average 2.83 correct answers, while mothers over 22 years knew on average 3.88 of the 5 answers ($p = .008$).

Discussion

The first aim of this study was to explore **what** knowledge mothers/guardians had concerning promoting their children's oral health. As can be seen in Table 1, the percentage of correct answers concerning both the age when a child should first see a dentist (25.7%) and the percentage of correct answers concerning when to start brushing a child's teeth (32.4%) were low. These percentages may reflect the low importance that mothers may place on taking care of children's primary teeth.¹⁴ On the other hand, the finding that 91.4% of the respondents correctly knew that children should not be put to bed with a bottle containing milk, formula, or juice was encouraging. However, as research showed before, merely knowing that a child should not be put to bed with a bottle may not lead to appropriate behavior as long as the mother did not understand the underlying reason for not engaging in this behavior.¹³

In this context, it is worthwhile to consider the way the mothers'/guardians' knowledge was assessed. One might wonder whether the question/answer format chosen in this study was the best possible way to assess this concept. Without any doubt, asking open-ended questions could have resulted in data that would have reflected the depth and complexity of the mothers' knowledge much more accurately. However, there are 2 reasons why the open-ended answer format was not chosen. First, the analyses of open-ended answers are much more complex, and comparisons between subgroups of a sample are much more difficult to achieve. Data collected with a closed-ended answer format undoubtedly offer a better way to compare groups of respondents. Second, it is worthwhile to consider if an instrument could be developed that could be used to assess mothers'/guardians' knowledge in a quick and easy fashion. The fact that more than half of the mothers did not want to answer the survey themselves may suggest that the functional reading level of many mothers was relatively low. The chosen answer format was relatively easy to respond to. On the whole, there are benefits to having an instrument that allows a quick glance at a parents' knowledge concerning oral health issues. Such an instrument could be used to help providers identify what concrete issues should be addressed when interacting with parents. Another group of researchers has developed an instrument to assess parents' knowledge about their children's oral health issues.³⁰

Concerning the second aim of this study, namely to investigate which parents/guardians should be specifically targeted to receive the 4 types of information and to identify the factors that predicted the degree to which mothers had knowledge about these 4 areas of concern, a number of significant relationships were found. Concerning the role of sociodemographic factors, the analyses showed that the age of the mothers was related to the average number of correct answers concerning (a) the prevention of oral disease; and (b) the consequences of poor oral health (see Table 3). It was interesting that age, per se, was not significantly correlated with the knowledge indices (see Table 2)-most likely due to the wide range of ages. However, as can be seen in Table 3, a comparison of the knowledge scores concerning prevention of oral disease and the consequences of poor oral health showed that the average scores of younger mothers (under 23 years of age) were significantly different from the average scores of older mothers (over 22 years of age). This result should alert dental care providers to the importance of finding ways to provide dental health information to younger mothers. Efforts to reach young pregnant women may be especially important, because pregnant mothers and mothers of 1 or 2 children knew less about the prevention of oral disease than mothers with 3 or more children (see Table 3).

Not surprisingly, it was found that mothers with lower incomes (under \$1000 per month) had less knowledge concerning the utilization of health care services than mothers with higher incomes. This finding stresses how important it is to inform socioeconomically disadvantaged mothers about the ways their children can receive dental care, eg, in community dental clinics, and at which age they should start bringing their children for a first dental visit.

In addition to considering sociodemographic factors as determinants of who should be targeted for educational interventions concerning promoting children's oral health, it was also found that oral health-related factors such as the respondents' own health behavior, their prior dental experiences, and dental fear may be important. Not surprisingly it was found that the

more positive the respondents' own health behavior was (namely how often they brushed their own teeth and flossed), the more they knew about promoting their children's oral health. These findings concerning the relevance of mothers' own health behavior point to the significance of educating mothers' about promoting their own oral health as well as their child's oral health. Oral health promotion should be a family matter.²⁵ It was also not surprising to find that the more restorations mothers had, the more they knew about the consequences of poor oral health (see Table 2). One potential explanation could be that once the respondents had experienced for themselves how much their quality of life was decreased by having poor oral health, they might be better prepared to clearly assess the effects of poor oral health on their children. However, the fact that the number of fillings was not significantly correlated with the mothers' knowledge about appropriate health behavior could be a sign that these respondents had not received sufficient dental health education when they were treated for dental caries.

In addition, the role of dental anxiety should not be underestimated because it was a significant predictor of the knowledge index concerning health behavior. Previous research showed quite convincingly that children's, adolescents,' and parents' dental fear are related with avoiding dental care and a lack of dental care utilization.³¹⁻³⁴ It is therefore noteworthy to find that dental fear might not only be related with dental care utilization, but also with knowledge concerning oral health behavior.

There are some factors that limit the generalizability of these findings. The sample size was low and the sample was not representative of mothers / guardians in general because the data were collected at a community pediatric dental clinic. In addition, the format of the questions might have given the respondents an opportunity to guess the correct answers. However, despite these limitations it seems worthwhile to consider these findings and start a process of developing strategies of targeting especially vulnerable populations for receiving specific types of health information.

Collaborations between oral health care providers and social service community programs, as well as general health providers, could make a difference in the level of information about oral health promotion that parents and guardians have.³⁵ In an ideal world, all parents and guardians would, of course, receive a comprehensive education about promoting their children's oral and general health early on in their child's life, and subsequently as the child grows up. However, even in a country as affluent as the United States, certain segments of the population are less likely to receive oral health care and thus do not have the benefits of interactions with health care providers that could result in education about oral health issues. It seems therefore crucial to consider what information should be targeted at specific groups of parents and guardians.³⁶ Recent research on the effects of motivational interviewing when educating mothers highlight an opportunity for future research.³⁷ Combining these findings concerning how to educate mothers with the findings from this study concerning (a) the content of educational interventions, as well as (b) which groups of parents should be especially targeted could result in a comprehensive approach to developing better educational interventions.

Conclusions

The findings examine the question who knows what. The results suggest targeting mothers and caregivers of younger children about promoting their children's oral health, especially about when to start with brushing their children's teeth and utilizing oral health care services. In addition, it can be concluded that special efforts should be made to educate younger mothers/guardians, as well as first time mothers and mothers with less than 3 children, about promoting their children's oral health. Concerning the content of educational efforts, it can be concluded that mothers from lower income families need to be informed about (a) the importance of utilizing preventive dental care services for their children; and (b) how they can gain access to dental care for their children. However, it is important to stress that the mothers/guardians should not merely be educated about promoting their children's oral health, but that oral health education should make oral health promotion a family matter. The study showed that the more mothers engaged in good dental health-related behavior for themselves, the more likely they were to know more about promoting their children's oral health. Finally, the importance of reducing dental fear in mothers should not be overlooked. High levels of dental anxiety in mothers may lead to ignorance about oral health-related behavior and avoidance of oral health care services not only for the mothers, but also for their children.

Acknowledgements

This research was supported by an AADR Student Research Fellowship to Aisha Akpabio. We want to thank Drs. Briskie and Eboda, Carol Lutey, and the staff of the pediatric dental clinic at Mott Children Health Center in Flint, Mich, for their support with this study.

Notes

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