



American  
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Hygienists'  
Association

# Journal of Dental Hygiene

August 2020 • Volume 94 • Number 4

- Scholarly Inquiry and Research: An assessment of graduate dental hygiene schools' requirements
- Teledentistry Knowledge and Attitudes: Perspectives on the role of dental hygienists
- Mental Health and Self-Care Practices Among Dental Hygienists
- The Effect of Mobile Text Messages and a Novel Floss Holder on Gingival Health: A randomized control trial
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- Adolescents' Perceived Risk of Harm Due to Smoking: The role of extracurricular activities
- 2020 Dentsply Sirona/ADHA Graduate Student Research Abstracts

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## Statement of Purpose

The Journal of Dental Hygiene is the refereed, scientific publication of the American Dental Hygienists' Association. The JDH promotes the publication of original research related to the profession, education, and practice of dental hygiene and supports the development and dissemination of a dental hygiene body of knowledge through scientific inquiry in basic, applied and clinical research.

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## COVID-19: Education and Licensure Disruption



Rebecca L. Stolberg,  
RDH, MSDH

In a matter of one week, all dental hygiene programs in the U.S. and Canada were closed. Dental offices across the nation were closed; and everyone was told to “stay at home”. Thus began months of what could only be imagined in a Netflix® horror movie. Dental hygiene as a profession, and its education, would never be the same.

For the past few months dental hygiene program directors, faculty, students, professional associations, state dental boards, and legislators have been grappling with COVID-19. Universities and colleges were closed. All external rotations were cancelled. When and how could students and faculty safely return to campus? How will students get licensed when regional licensing examination were closed? Will patients feel comfortable returning to the campuses for dental care from the students? How will these issues be addressed by the Commission on Dental Accreditation (CODA)? When will students be able to sit for the Dental Hygiene National Board Examination? As of today, many programs have been able to return to campus in some capacity; others will not return until January 2021, greatly delaying student graduation and licensure.

CODA released a statement allowing programs to maximize on-line learning. If faculty could demonstrate competency assessment on-line, it was acceptable. Program directors and faculty had the opportunity to think outside the box and find new ways to insure graduates were competent. Dental hygiene faculty now have a huge cadre of on-line assessment and teaching methods that stretched their creativity and skills. The immediate move to on-line only education required stamina, patience and collaboration. Webinars focusing on creative and useful on-line learning methodologies flourished. Discussion boards lit up. Document sharing was rampant.

If students were competent, the issue now was licensure. The American Dental Hygienists' Association (ADHA), the American Dental Education (ADEA) and the American Dental Association (ADA) have been working diligently on the elimination of single encounter live patient clinical examination for licensure long before the era of COVID-19. The Coalition for Modernizing Dental Licensure was formed in October 2018 to move this agenda forward. State governors and dental boards were motivated like never before to move on this issue because live patient clinical examinations could not be held, nor could they be held in the near future, given the social distancing requirements and amount of Personal Protective Equipment (PPE) necessary to conduct an exam. Regional testing agencies began the race of a lifetime developing manikin base exams for consideration. States such as Washington, Utah, Illinois, and Vermont chose to allow temporary licensure to dental hygiene graduates until such time a regional board examination can be conducted. In addition, thanks to the efforts of dental hygiene educators rallying their state legislators and dental boards, some states, such as Oregon, Arkansas, and Texas, now allow for manikin-based exams for dental hygiene licensure indefinitely. If there is one positive outcome of COVID-19 for dental hygiene education, it is that states have begun to understand that a single encounter live patient examination is not in the best interests of students, patients, and is not possible during a national crisis.

The National Dental Hygiene Board Examination still poses another licensure barrier. When the virus hit, over 5,000 dental hygiene students had not yet taken the nine-

hour, dental hygiene national board. This examination, administered at computerized testing centers, had come to a standstill across the nation. Months of testing appointments were cancelled. Computerized testing has resumed in most states, and fortunately the Joint Commission on National Dental Examinations reduced the exam time by half, so that more applicants could test in a day.

Dental hygiene program clinics have begun to re-open. Dentistry, well versed in blood borne pathogens, must now deal with airborne pathogens. New issues involve lack of appropriate PPE, social distancing, appropriate air filtration, and appropriate barriers in open bay clinics. In school dental clinics where there is not six foot spacing between chairs, only every other operatory may be used or some sort of barrier must be built/placed between chairs. Banning the use of ultrasonics has made a huge impact on all dental hygienists. Students taking regional licensure examinations on live patients, will be doing without the use of ultrasonic instruments - a return to the 1980's!

The future effects of COVID-19 on dental education are yet to be realized. Budgets are of grave concern. While students don't generate large amounts of income in the educational clinics, some programs rely on that income to stay in business. Colleges of all sizes, in all locations, are facing large budget shortfalls due to decreased state government support and/or loss of income from students leaving campuses and dormitories. Some colleges have refunded tuition and dorm dollars. Program directors are forced to deal with budget shortcomings while also purchasing more PPE than ever. The long-term impacts of such budget shortfalls are yet to be actualized.

Along with the pandemic, a national crisis on diversity and inclusion has surfaced. What are the mental health considerations for dental hygiene students and faculty returning to their campus communities? Faculty have lost loved ones. Students have lost jobs. Families have lost security. Dental hygiene programs are working hard to provide an equitable inclusive, safe, supportive and welcoming environment for all students.

The role of the professional association has never been more important. The sense of community and networking offered by associations such as ADHA, is unmeasurable in times like this. The 24-7 advocacy work our association on

behalf of dental hygiene programs to include dental hygiene in relief packages, and to also include dental hygiene clinics in these relief packages and obtainment of PPE from FEMA, are unmeasurable. These examples and experiences should be more than enough to convince every graduating dental hygiene student the value of their membership in ADHA. Without association leadership and advocacy, dental hygiene as a profession, and the faculty who educate our future professionals, would not be surviving and even thriving, during COVID-19.

***Rebecca L. Stolberg, RDH, MS*** is the Senior Director of Allied Dental Education and Faculty Development at the American Dental Education Association in Washington, DC.

## Scholarly Inquiry and Research: An assessment of graduate dental hygiene schools' requirements

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Christopher J. Van Ness, PhD; Cynthia C. Gadbury-Amyot, RDH, MSDH, EdD

### Abstract

**Purpose:** Scholarly inquiry and research are core competencies for graduate dental hygiene education as defined by American Dental Education Association (ADEA). The purpose of this study was to examine how graduate dental hygiene programs in the United States (US) are meeting these competencies.

**Methods:** The study sample consisted of the graduate programs in the US that award a terminal degree specific to dental hygiene ( $n=14$ ). Graduate program directors were invited via email to participate in an electronic survey. The survey questions were developed based on the ADEA graduate dental hygiene education competency for scholarly inquiry and research. Descriptive statistics including frequencies and percentages were used to analyze the data. Exploration of relationships between variables were conducted using correlational analyses and t-tests.

**Results:** A response rate of 71% was achieved ( $n=10$ ). There was a significant difference in the minimum number of scholarly activity requirements between programs with lower student enrollments ( $M=4.43$ ,  $SD=1.61$ ) versus those with higher enrollments ( $M=2.00$ ,  $SD=0$ ;  $t(8)=2.51$ ,  $p=.036$ ). A negative correlation was found between the submission of a manuscript to a peer reviewed journal and the number of students accepted per year in the graduate program ( $r(10) = -.655$ ,  $p <.05$ ), indicating that students graduating from programs with larger enrollments were less likely to submit their scholarly work for publication.

**Conclusions:** All program directors reported requiring students to participate in at least one scholarly activity as defined in the ADEA Core Competencies for Graduate Dental Hygiene Education. Program size was the biggest variable in relationship to the number of scholarly requirements. Schools with smaller enrollments required their students to participate in over twice the number of scholarly activities as compared to programs with larger enrollments. More research is needed to evaluate how graduate level dental hygiene programs are meeting the ADEA competencies.

**Keywords:** scholarship, scholarly activities, research, dental hygiene graduate education

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### Introduction

The dental hygiene profession has the potential to grow exponentially in the near future. Multiple states are passing legislation supporting advanced practice acts and there has been renewed discussion regarding the possibility of a dental hygiene doctorate degree. As public understanding of the relationship between oral and systemic health grows, dental hygienists are positioned to fill greater roles of responsibility in the healthcare system, and a body of knowledge specific to the dental hygiene discipline will be crucial to this advancement.

The American Dental Hygienists' Association (ADHA) has long recognized the importance of original research in its strategic vision to advance the profession.<sup>1</sup> Graduate education provides the foundation for the development of scholars who are able to participate in the conduct and generation of research that ultimately validates the dental hygiene discipline. However, graduate dental hygiene programs are not required to go through an accreditation process with the Commission on Dental Accreditation (CODA) and this can result in large variances in program requirements and rigor.

In 2011, ADHA collaborated with the American Dental Education Association (ADEA) to develop the ADEA Core Competencies for Graduate Dental Hygiene Education.<sup>2</sup> The core competencies emphasize the importance of developing scholar researchers and preparing dental hygiene professionals to assume leadership roles in health care and education. Purposes outlined for the creation of the document include: 1) to concisely establish the competencies expected of graduates, 2) to offer direction to graduate dental hygiene programs in regards to curriculum development, enhancement, and establishment of a benchmark of educational quality, and 3) to assist new professionals by defining what it means to be a graduate of a master's degree program in dental hygiene and offer direction to those seeking a graduate degree in the profession.<sup>2</sup> Eight core competencies were defined, including scholarly inquiry and research.

### National Dental Hygiene Research Agenda

The ADHA published its first National Dental Hygiene Research Agenda (NDHRA) in 1993.<sup>3</sup> The agenda supported the organization's strategic vision for the advancement of the profession and was intended to serve as a framework to guide researchers in adding to the body of knowledge unique to dental hygiene.<sup>1</sup> The most recent version of the ADHA Research Agenda was released in June of 2016.<sup>1</sup> The revised agenda highlights the need to focus research efforts on questions that will support the growth of the profession. The authors of the 2016 agenda stated that the revisions were intended to promote research that will assist in the further transformation of dental hygiene as a profession, along with facilitating interprofessional collaboration and practice.

There is a gap in the literature regarding how scholarly inquiry and research is addressed in graduate dental hygiene education. It is unknown whether these programs are addressing this particular competency as one of the eight core competencies for graduate dental hygiene education, as set forth by the ADHA and ADEA. Research unique to the discipline of dental hygiene is fundamental for the advancement of the profession, however the role of graduate dental hygiene education requirements with regards to the publication of peer-reviewed graduate research is unknown. The purpose of this study was to examine how graduate dental hygiene degree programs in the US are meeting the ADEA/ADHA core competency for scholarly inquiry and research.

### Methods

This descriptive research survey study design was deemed exempt by the University of Missouri, Kansas City Institutional Review Board (#18-363). Survey questions were

developed by the authors using ADEA Core Competencies for Graduate Dental Hygiene Education, Competency eight: *Scholarly Inquiry and Research*.<sup>2</sup> Since these guidelines were first published in 2011, it was determined that all programs would have had adequate time for implementation. Program directors of the schools in the US awarding graduate degrees specific to dental hygiene dental hygiene were invited to participate (n=14, Table I).<sup>4</sup> Only programs awarding a Master of Science degree in Dental Hygiene were included in the study sample obtained from the ADHA website.

### Survey instrument

Using the sub-competencies for *Scholarly Inquiry and Research*, an investigator designed survey was developed to include: 1) apply the research process to an identified problem, 2) demonstrate professional writing and presentation skills in the dissemination of research findings, 3) conduct a comprehensive systematic literature search relevant to a specific topic and critically evaluate the evidence gathered, 4) demonstrate skill in proposal development and writing, 5) analyze and interpret quantitative and qualitative data from the research literature to guide problem-solving and evidence-based decision making, 6) synthesize information from evidence-based literature to apply to a community health, education, clinical practice and/or research problem, 7) design and implement a scholarly project in an area of emphasis.

The survey consisted of three parts. Part one consisted of five demographic questions including average number of years it takes students to complete the program, number of credit hours required for graduation, type of academic units used, average number of credit hours taken by students per semester, and the number of students accepted each calendar year. The second part of the survey had four items addressing scholarly inquiry and research with two of those questions related specifically to the ADEA sub-competencies. Participants were asked to identify which of the sub-competencies were part of the required curriculum, as well as the percentage of time devoted to each sub-competency. The two remaining questions in this section examined minimum requirements for scholarly activities, and the resources available to graduate students at their respective institutions. Part three of the survey consisted of four retrospective questions regarding the number of graduates and scholarly activity over the past five years.

The survey was pilot tested for validity by three faculty members from the University of Missouri Kansas City, School of Dentistry (UMKC-SOD) with experience in survey and program development. Following minor changes, the survey, including cover letter and informed consent, was

**Table I. US graduate programs with a Master of Science in Dental Hygiene degree\***

University of California; San Francisco**	<a href="https://dentistry.ucsf.edu/programs/dental-hygiene">https://dentistry.ucsf.edu/programs/dental-hygiene</a>
University of Bridgeport, Fones School of Dental Hygiene	<a href="https://online.bridgeport.edu/degrees/master-dental-hygiene">https://online.bridgeport.edu/degrees/master-dental-hygiene</a>
Idaho State University	<a href="http://coursecatisu.edu/graduate/healthscience/dentalhygiene/#text">http://coursecatisu.edu/graduate/healthscience/dentalhygiene/#text</a>
Massachusetts College of Pharmacy and Health Sciences (MCPHS, Forsyth School of Dental Hygiene)	<a href="https://www.mcphs.edu/academics/school-of-dental-hygiene/dental-hygiene">https://www.mcphs.edu/academics/school-of-dental-hygiene/dental-hygiene</a>
University of Michigan	<a href="http://www.dent.umich.edu/about-school/department/pom/dental-hygiene/dental-hygiene-masters-degree">http://www.dent.umich.edu/about-school/department/pom/dental-hygiene/dental-hygiene-masters-degree</a>
University of Minnesota	<a href="https://www.dentistry.umn.edu/degrees-programs/dental-hygiene/master-science">https://www.dentistry.umn.edu/degrees-programs/dental-hygiene/master-science</a>
University of Missouri-Kansas City	<a href="https://dentistry.umkc.edu/academics/dental-hygiene-education-master-of-science/">https://dentistry.umkc.edu/academics/dental-hygiene-education-master-of-science/</a>
University of North Carolina	<a href="https://www.dentistry.unc.edu/academicprograms/dh/msdh/">https://www.dentistry.unc.edu/academicprograms/dh/msdh/</a>
University of New Mexico	<a href="http://online.unm.edu/online-programs/dental-hygiene-m.s.html">http://online.unm.edu/online-programs/dental-hygiene-m.s.html</a>
Ohio State University	<a href="https://dentistry.osu.edu/prospective-students/dental-hygiene-programs/graduate-program-dental-hygiene">https://dentistry.osu.edu/prospective-students/dental-hygiene-programs/graduate-program-dental-hygiene</a>
University of Texas Health Science Center at San Antonio	<a href="http://www.uthscsa.edu/academics/dental/departments/periodontics/dental-hygiene/master-science">http://www.uthscsa.edu/academics/dental/departments/periodontics/dental-hygiene/master-science</a>
Old Dominion University	<a href="https://odu.edu/dental/dental-hygiene-overview#tab102=2">https://odu.edu/dental/dental-hygiene-overview#tab102=2</a>
Eastern Washington University	<a href="https://www2.ewu.edu/chsph/programs/dental-hygiene/master-of-science-in-dental-hygiene">https://www2.ewu.edu/chsph/programs/dental-hygiene/master-of-science-in-dental-hygiene</a>
West Virginia University	<a href="https://dentistry.hsc.wvu.edu/education/programs/dental-hygiene-programs/master-of-science/">https://dentistry.hsc.wvu.edu/education/programs/dental-hygiene-programs/master-of-science/</a>

\* Study sample, programs accepting students as of fall 2018

\*\* Program on hiatus since 2019-20 academic year

sent to dental hygiene graduate program directors via an online survey platform (Qualtrics; Provo, UT). Participants were asked to reply within two weeks and informed that their answers would be anonymous. A follow up email was sent at the conclusion of the initial two-week period, inviting non-respondents to take the survey. Data were analyzed using the statistical software program SPSSv25 (IBM Corp., Armonk, NY). Descriptive statistics including frequencies and percentages were calculated. Exploration of relationships between variables were conducted using correlational analyses and t-tests.

## Results

An overall response rate of 71% was achieved (n=10). Participants reported that students take an average of 1-4 years to complete the graduate programs, with 34 to 41 credit hours required for graduation. Students take an average of 3-9 credit hours per semester, and programs accept anywhere from 4-20 students per year. All programs use semesters to define academic units. Program characteristics are shown in Table II.

In the second part of the survey, respondents were referred to a list of activities associated with the ADEA *Scholarly Inquiry and Research* sub-competencies<sup>2</sup> (Table III). The participants were asked to indicate which of those scholarly inquiry and research sub-competency activities were included in their required curriculum. Finally, they were asked to estimate the percentage of time devoted to each required activity identified in the previous step. The participants did not appear to understand the intent of the final step as results for this item totaled greater than 100%. Because the data were not interpretable, they were excluded from further analysis. Over half, 67% (n=8) of the scholarly inquiry and research activities included in the survey were identified as required curriculum by all respondents. Writing a research proposal (90%) and conducting a systematic literature review (80%) were required by the majority of programs. Grant proposal writing and conducting case reports or case series were indicated as required curriculum elements by fewer programs (50% and 30%, respectively).

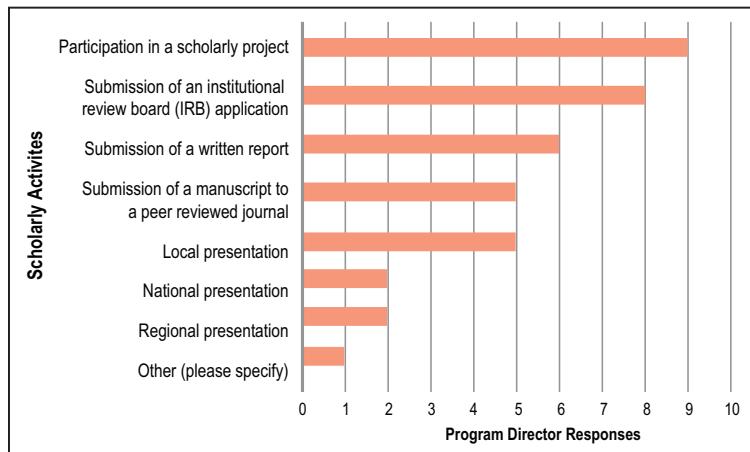
The reported minimum requirements for scholarly inquiry and research are shown in Figure 1. Participation in a scholarly project (90%), and submission of an institutional review board application (80%) were the two most frequency reported requirements followed by submission of a written report (60%), submission of a manuscript to a peer review journal (50%) and a local presentation (50%). National and

**Table II. General program characteristics:**

	Minimum	Maximum	Mean
On average, how many years do students take to complete your program?	1	4	2.4
How many credit hours does your program require for graduation?	34	41	36.8
What is the average number of credit hours taken per semester?	3	9	7.3
How many students do you accept into the program in a calendar year?	4	20	8.5

regional presentations were identified as requirements by a much lower percentage of the respondents (20% and 10% respectively).

Program directors were asked about resources offered to students enrolled in the participating programs to assist with scholarly inquiry (Table IV). All programs (100%) reported having a faculty mentor to assist with the research process and most (70%) reported having a statistician and/or research director. A positive correlation was found between the availability of a research director and submission of a manuscript to a peer reviewed journal ( $r=.655$ ,  $n=10$ ,  $p=.04$ ). In addition, a positive correlation was also found between availability of a statistician and the submission of a manuscript to a peer reviewed journal ( $r=.655$ ,  $n=10$ ,  $p=.04$ ). Programs where students have access to a statistician and/or a research director were more likely to have students submit their manuscripts to a peer reviewed journal.

**Figure 1. Minimum requirements reported for scholarly inquiry and research (n=10)****Table III. List of scholarly inquiry and research activities and activity percentage of the required curriculum (n=10)**

Activity	n (%)
Conducting case reports or case series (with references).	3 (30%)
Writing a grant proposal.	5 (50%)
Conducting a systematic literature review.	8 (80%)
Writing a research proposal.	9 (90%)
Applying the research process to an identified problem.	10 (100%)
Applying professional skills in the dissemination of research findings.	10 (100%)
Applying professional presentation skills in the dissemination of research findings.	10 (100%)
Submitting a proposal to an IRB review board.	10 (100%)
Completing original research studies.	10 (100%)
Analyzing and interpreting qualitative and quantitative data.	10 (100%)
Synthesizing information from evidence-based literature to apply to a community health, education, clinical practice, and/or research problem.	10 (100%)
Designing and implementing a scholarly project.	10 (100%)

Due to the large variance in program enrollment and size, the variable of program was dichotomized for further analysis. Programs accepting 10-20 students a year formed one group, and those accepting 4-9 students a year formed the second group. In addition, scholarly activities marked as required by the program director, were summed to create a frequency scale reflecting the degree of scholarly activity characteristic of each program. A *t*-test was conducted to evaluate program scholarly activity as indicated in part two of the survey. The test was significant, ( $t(8) = 2.51$ ,  $p = .03$ ) with programs accepting 10-20 students a year reporting a significantly lower degree of scholarly activity ( $M=2.00$ ,  $SD=0$ ) as compared to schools with smaller enrollments of 4-9 students per year ( $M=4.43$ ,  $SD=1.61$ ). Further, a negative correlation was found between submission of a manuscript to a peer reviewed journal and the number of students accepted per year, ( $r = -.655$ ,  $n = 10$ ,  $p = .04$ ). Programs with lower enrollments were significantly more likely to graduate students who submitted manuscripts to peer review journals.

The third part of the survey included a series of retrospective questions spanning over a period of five-years (Table V). Two hundred and forty-six students have

**Table IV. Resources available for scholarly inquiry (n=10)**

	Mean	SD	Frequency	Percent
Scholarship review committee	.40	.516	4	40.0
Research track within your program	.40	.516	4	40.0
Research Director	.70	.483	7	70.0
Statistician	.70	.483	7	70.0
Faculty Mentor	1.00	.000	10	100.0
Other (Focus Groups)	.10	.316	1	10.0

**Table V. Number of graduates and scholarship activities in the past 5 years (n=10)**

	Minimum	Maximum	Mean	Total (%)
How many students graduated from your program in the past 5 years?	12	65	24.6	246(NA)
In the past 5 years, how many students have presented their scholarly activity at a regional conference?	0	15	3.8	37(15%)
In the past 5 years, how many students have presented their scholarly activity at a national/international conference?	2	15	5.5	54(22%)
In the past 5 years, how many students have published their scholarly activity in a peer-reviewed journal?	2	10	6.5	64(26%)

graduated from the participating dental hygiene programs (n=10) over the past five years. Of those graduates, 15% presented at a regional conference (n=37), 22% had presented at a national or international conference (n=54), and 26% had manuscripts published in peer reviewed journals (n= 64). Exploration of the relationship between the reported requirement of submission of a manuscript to a peer-reviewed journal and subsequent publication in the past five years, identified that institutions that required submission of a manuscript to a peer-reviewed publication were also more likely to report graduates who had published in the past 5 years ( $r(10)=.683, p<.05$ ).

## Discussion

The purpose of this study was to address how graduate dental hygiene programs in the US are meeting the scholarly inquiry and research competency as defined in the ADEA Core Competencies for Graduate Dental Hygiene Education. The initial investigation at comparing program requirements proved difficult to interpret for a variety of reasons. First, words such as thesis, non-thesis, special project, and capstone project are used interchangeably. Second, program lengths can vary anywhere from 12 months to 7 years. Third, some programs offering the same terminal degree allow students to pursue different “tracks” or areas of emphasis, meaning that while the degree awarded might be named the same (master of science) the requirements are quite different. For the purpose of this study, scholarship and research was defined according to the ADEA Core Competencies for Graduate Dental Hygiene Education, (Competency 8, *Scholarly Inquiry and Research*).<sup>2</sup> Using this document as a common parameter, the researchers were able to eliminate confusion ensuing from words such as thesis/non-thesis, and create a metric that would allow reasonable comparison across programs.

The magnitude of the significance of scholarship and research in graduate education and its contribution to the advancement of the profession, is supported by national organizations such as ADEA and ADHA, as well as within the educational institutions themselves. Universities generally define graduate education as the discovery, preservation and dissemination of knowledge. The importance of research is so ingrained in higher education that universities are found to address its significance in their mission and values statements.<sup>5</sup> While the importance of scholarship and research is stressed, there are obvious barriers that have been noted in the literature. Studies examining graduate education

in nursing,<sup>6-7</sup> emergency medicine,<sup>8</sup> and obstetrics and gynecology<sup>9</sup> have identified a variety of obstacles including a lack of time devoted to the process in the curriculum, lack of adequate staff to serve as mentors, and insufficient support from the administration. Results from this study of graduate dental hygiene education corroborates that when graduate students have access to research mentors/directors and statisticians (adequate staff), they are more likely to submit their manuscripts to a peer reviewed journal. The results also indicated that when submission of a research manuscript to a peer-reviewed journal is a program requirement, those students are significantly more likely to ultimately have their work published. While this study endeavored to quantify the amount of time devoted to scholarship and research, the resulting data were not interpretable. It would be interesting in future studies to try and determine more closely the amount of time allocated to these activities in the graduate dental hygiene program curriculum and conduct comparative analysis to determine optimal time commitments dedicated to the generation and dissemination of knowledge. This information would be helpful for addressing the lack of time devoted to the process of scholarship and research barriers identified in the curriculum.

Since the ADEA Core Competencies were approved and released by their ADEA House of Delegates in 2011, it seemed reasonable that programs would have had adequate time to adopt these national competencies. This study identified a great deal of variability still exists across programs' scholarly inquiry and research requirements. Variations in program size was found to be the biggest factor in determining the amount and level of requirement difficulty. Results show that schools with smaller enrollments require over twice the amount of scholarly activity as their larger counterparts. As noted in the research from nursing, emergency medicine, and obstetrics, administrative support is critical for fostering scholarship and research.<sup>6-9</sup> Discussion between the graduate programs and their respective administrations is key in regards to determining the mission and goal of graduate education at their institutions. As a profession, it will be important to continually scan the environment of graduate dental hygiene education to ensure that an emphasis on scholarship and research continues to be a priority and ultimately results in the generation and dissemination of new knowledge.

The second research question guiding this study inquired whether the research requirements of graduate dental hygiene programs are contributing to the advancement of the profession through published peer-reviewed research. One-half (50%) of programs reported submission of a manuscript to a peer reviewed journal as a program requirement, with

one-fourth (26%) of all graduates (n=246) in the past 5 years publishing their research. This important finding needs further examination from both an institutional and a professional perspective. As discussions continue around doctoral level education in dental hygiene, preparing students at the graduate level will be critical for their success with doctoral education and research.<sup>10-12</sup>

This study had limitations. There is always the potential for responder bias with a self-reporting survey. Program directors may have overestimated their programs participation in scholarly inquiry and research. Data obtained from this survey was completely dependent on the participants own knowledge and recollection. Also, given the small number of graduate dental hygiene education programs (n=14), it would have been even more informative to have had a 100% response rate.

This is the first study to examine how graduate dental hygiene programs are meeting the ADEA competency of scholarly inquiry and research. Further refinement of the survey would be beneficial since there appeared to be a disconnect in reported responses, minimum requirements and percentage of time spent on each sub-competency. Future research should also examine how graduate dental hygiene programs are preparing students for possible doctoral level dental hygiene education as well as how programs are fulfilling the other seven core competencies. Perceptions of graduates, in regards to their preparedness in meeting all of the ADEA core competencies, would be informative from the both the educational and professional perspective.

## Conclusion

All of the dental hygiene graduate program director respondents reported requiring students to participate in at least one scholarly activity as defined in the ADEA Core Competencies for Graduate Dental Hygiene Education. Program size was the biggest variable in relationship to the number of scholarly requirements. Schools with smaller enrollments required their students to participate in over twice the number of scholarly activities as compared to programs with larger enrollments. In order to advance the dental hygiene profession, programs awarding a graduate degree in dental hygiene need to prepare their students with the tools and knowledge to contribute scholarly work beyond the program requirement basics. Ongoing research is needed to evaluate how graduate level dental hygiene programs are meeting the ADEA competencies. More information and discussion among stakeholders will also better prepare the profession in moving towards a doctorate degree.

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## References

1. Lyle DM, Grill A, Olmsted J, et al. National dental hygiene research agenda. *J Dent Hyg.* 2016; 90 (suppl 1):43-50.
2. American Dental Education Association. ADEA core competencies for graduate dental hygiene education [Internet]. Washington, DC: American Dental Education Association; 2018 [cited 2018 Nov 15]. Available from: <https://www.adea.org/cadpd/allied-dental-education-resources.aspx>
3. Spolarich AE, Davis C, Peterson-Mansfield S, et al. The ADHA national research agenda: white paper by the ADHA 1993-1994 council on research. *J Dent Hyg.* 1994; 68(1):26-9.
4. American Dental Hygienists' Association. Master of science in dental hygiene (MSDH) and masters'/doctoral degree in related discipline [Internet]. Chicago, IL: American Dental Hygienists' Association; 2018 [cited: 2018 Dec 18]. Available from: [http://www.adha.org/resources-docs/71619\\_MSDH\\_Programs.pdf](http://www.adha.org/resources-docs/71619_MSDH_Programs.pdf)
5. UMKC. Mission, vision, values. [Internet]. Kansas City: University of Missouri Kansas City; 2019 [cited: 2019 Aug 8]. Available from: <https://dentistry.umkc.edu/about-us/mission-vision-core-values/>
6. Emerson RJ, Records K. Nursing: profession in peril. *J Prof Nurs.* 2005; 21(1):9-15.
7. Adderly-Kelly B. Promoting the scholarship of research for faculty and students. *ABNF J.* 2003 Mar/Apr; 14(2):41-4.
8. Blanda M, Garson L, Dunn K. Emergency medicine resident research requirements and director characteristics. *AEM.* 1999; 6(4):286-91.
9. Oakley SH, Crisp CC, Estanol MV, et al. Attitudes and compliance with research requirements in Ob/Gyn residencies: a national survey. *Gynecol Obstet Invest.* 2013; 75:275-80.
10. Battrell A, Lynch A, Steinbach P, et al. Advancing education in dental hygiene. *J Evid Based Dent Pract.* 2014; 14 (suppl 1):209-21.
11. Nathe C. Graduate education in dental hygiene in the United States. *Dent Health.* 2005; 44(2): 22-3.
12. Walsh MM, Ortega E. Developing a scholarly identity and building a community of scholars. *J Dent Hyg.* 2013; 87 (suppl 1): 23-8.

## Teledentistry Knowledge and Attitudes: Perspectives on the role of dental hygienists

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### Abstract

**Purpose.** The first statewide teledentistry (TD) Summit in North Carolina (NC) was convened by the University of North Carolina (UNC) at Chapel Hill in 2018. The purpose of this analysis is to compare Summit participants' understanding of TD, its benefits, challenges, solutions and the role of dental hygienists, pre- and post-Summit.

**Methods.** Summit invitees included leaders in related policy, education, advocacy, legislation, technology and UNC dental hygiene and dental students. Descriptive analyses and exact McNemar's matched pair tests compared proportions of participants' responses to pre- and post-Summit surveys.

**Results.** Response rates were pre-Summit 75.3% (n= 58) and post-Summit 70.1% (n= 47); matched pre-post survey pairs (n=42). Pre-Summit respondents reported their primary role in administration (48.0%), teaching and mentoring (21.0%), patient care (12.0%) or as a student (19.0%). Among respondents, overall self-reported TD knowledge increased from 38.1% to 92.9%,  $p < 0.001$ . Their reported extent TD should be developed in NC increased from 78.6% to 95.2%,  $p = 0.07$ ; the extent hygienists should have a role in TD services increased from 83.3% to 88.1%,  $p = 0.73$ . The most frequently mentioned challenge was state practice acts requiring direct supervision of dental hygienists, limiting their TD use in community settings, which increased in the pre- to post-surveys from 33.3% to 59.5% respectively,  $p = 0.01$ .

**Conclusion.** Among attendees at the statewide TD Summit, self-reported knowledge was high and attitudes favorable for moving forward with TD in NC. However, state dental practice act barriers restricting dental hygienist participation in TD was the first challenge respondents thought needed to be addressed.

**Key Words.** teledentistry, dental hygiene, health services, access to care, health policy, telehealth, telemedicine

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### Introduction

According to Khan and Omar,<sup>1</sup> "Teledentistry (TD) can be defined as "the remote provision of dental care, advice, or treatment through the medium of information technology, rather than through direct personal contact with any patient(s) involved." It is a field whose roots lie in telemedicine. Telehealth is a broader term that includes telemedicine and TD. According to the website glossary of the American Telemedicine Association, now known as ATA, telehealth "is often used to encompass a broader definition of remote healthcare that does not always involve clinical services. Videoconferencing, transmission of still images, e-health including patient portals, remote monitoring of vital

signs, continuing medical education and nursing call centers are all considered part of telemedicine and telehealth."<sup>2</sup>

The initial TD concept was developed as part of the blueprint for dental informatics drafted at a 1989 conference in Baltimore, funded by the Westinghouse Electronic Systems Group.<sup>3</sup> The United States (US) Army's Total Dental Access (TDA) project in 1994 was considered to be at the forefront of the birth of TD. A traditional Plain Old Telephone System (POTS) was utilized with two different communication methods, real time, and store and forward.<sup>3</sup> In 1995, Rocca and colleagues conducted a pilot study in Haiti to connect a general dentist with a dental specialist in Washington DC, via a satellite

link.<sup>4</sup> The following year, an integrated services digital network (ISDN) – based TD was tested by the Department of Defense to establish a medical network in Bosnia to connect Army field dentists with dentists at five regional military medical centers in the US (Washington, Texas, California, District of Columbia, and Hawaii). Using commercially available technology, dentists transmitted radiographs, color images and full motion videos to remote field hospitals for diagnostic support. The main TD hub was at the Landstuhl Regional Medical center in Germany, where the data was integrated into the Internet and the commercial ISDN gateway link to the world.<sup>4</sup> In 1997, ISDN - based TD was tested in Belgium, Italy and Germany; subsequently, additional studies were conducted in the UK, Japan and Taiwan.<sup>5</sup>

Teledentistry has been used in several parts of the US, to increase access to care and provide screenings and referrals for vulnerable and underserved populations in locations such as school and pre-school settings, nursing homes and rural clinics.<sup>6,7</sup> It is also used in education for health professionals and continuing education.<sup>3</sup> Systematic reviews of the literature have demonstrated favorable results regarding diagnostic accuracy between TD and other assessment methods for the detection of early childhood caries in preschool children.<sup>8,9</sup> A randomized clinical trial compared TD to conventional screening and referral methods for new patients seeking orthodontic treatment.<sup>10</sup> There was moderate agreement, kappa = 0.46, between the two methods in patients being accepted for orthodontic treatment.<sup>10</sup>

The diagnostic efficacy of TD in oral diagnosis was demonstrated by comparing the TD diagnosis of oral lesions among nursing home residents with the reference standard diagnosis obtained from a clinical exam.<sup>11</sup> Teledentistry is also being used by dentists for consultations and referrals with dental specialists<sup>12,13</sup> and specialist supervision. One example is orthodontic treatment performed by general dentists but supervised remotely by orthodontists.<sup>14</sup> In Brazil, a cloud-based telediagnosis program, EstomatoNet, has been used for specialists to advise primary care dentists and physicians about their patients' oral mucosal lesions and whether referrals to specialists are recommended. This program greatly reduced the need for face-to-face consultation, an advantage where there are few specialists and long waiting and travel times for patients.<sup>15</sup> While a number of studies have evaluated the clinical aspects of TD, few studies have evaluated its economic impact or cost-effectiveness.<sup>16</sup>

In 2019, 2.4 million North Carolinians, almost a fourth of the population, resided in 175 dental health professional shortage areas located throughout the state.<sup>17,18</sup> Many of these counties are largely rural, creating a need for reaching people

with limited access to dental care who could potentially benefit from TD. In contrast, one study of telemedicine utilization in an insured population, found that telemedicine is frequently used in urban areas where convenience may be the driving factor rather than limited access to care.<sup>19</sup> Thus, TD benefits both those who need better access to dental care as well as the larger population who have access but also seek convenience.

Teledentistry models vary, but they typically employ several team members to support data collection, analysis, and provision of care. Dental hygienists are well positioned to facilitate screening, counseling, and referral in support of TD initiatives. Depending on state practice acts and additional training, some may provide preventive and therapeutic measures as well. The utilization of dental hygienists is essential in establishing a team focused on prevention and education, in addition to the identification of dental disease and treatment needs.

Although TD has been in existence for over 30 years, it is relatively new in North Carolina (NC). The current environment for TD is more restrictive than many other states due to current state legislative regulations and policies. In order to learn more about TD and share ideation, a task force held the first statewide summit in October 2018. Participants included individuals holding positions with the ability to overcome current challenges and advance TD, if desired. The goals of the Summit included increasing participants' knowledge and understanding of TD, reimbursement and regulatory policies, information technology options, benefits, challenges and solutions. The purpose of this study was to compare participants' pre- and post-Summit self-reported knowledge and attitudes toward TD, the potential role of dental hygienists, and to determine priorities for overcoming barriers to implementation.

## Methods

The study was reviewed by the University of North Carolina at Chapel Hill (UNC) Office of Human Research Ethics and determined exempt (Study #18-2039). A planning committee and professional facilitator led the planning and implementation of the Summit. The individuals invited to the Summit (n=77) included experts in telemedicine, information technology, oral health and related policy, leaders in dental education, advocacy, business, organized dentistry and dental hygiene, representatives from health insurers, foundations and legislators and selected UNC students (8 dental students, 1 dental hygiene student, and 1 dental hygiene master's student). The Summit consisted of oral

presentations describing the use of telemedicine and UNC's Health Care's 24/7 Virtual Urgent Care Center in NC,<sup>20</sup> a video TD demonstration, and the role of TD in California in the provision of the Virtual Dental Home System of Care in community sites.<sup>21</sup> Six afternoon breakout groups were held with the following topics: 1) private practice, 2) community, 3) education, 4) information technology, 5) policies, and 6) finance/reimbursement. Participants were asked to address key questions in each of their domains and share highlights of each group's discussion.

The survey questions were developed by a subset of the planning group. Pilot-testing was conducted with 3 individuals who were invited but had indicated, prior to the pilot-testing, that they were unable to attend the event. Pre-Summit surveys were distributed via e-mail using online software (Qualtrics<sup>®</sup>; Provo, UT) to the individuals who indicated that they planned to attend the Summit (n=77). Post- surveys were sent to the Summit attendees (n=67). The e-mail described the survey and confidentiality process; consent was indicated by clicking the survey link. The initial pre-Summit survey mailing was sent twice, ten and four days before the event. Post-Summit survey e-mails were sent two and four weeks following the event. No names were recorded on the surveys. To maintain confidentiality and permit matching of individual pre-and post-Summit surveys, the initial five questions on the surveys were used for each respondent to create a unique ID (i.e., what is the first letter of your favorite color). Questions regarding participants' professional roles were only asked on the pre-Summit survey.

Respondents evaluated the format and content of the program in the post-Summit survey. The surveys consisted of questions asking participants to rate the extent of their overall knowledge about TD, and extent of their current knowledge of NC telemedicine policies for Medicaid reimbursement, (a joint state and federal funded program that assists low-income families with healthcare, including basic dental services), each on a scale of 1 (no knowledge) to 7 (very knowledgeable). Responses were grouped from 1-4 and 5-7 to create a derived binary variable for analysis.

Participants were asked to rank the extent to which TD should be developed in NC, and the extent to which dental hygienists should have a role in the delivery of services through TD in NC ranging from 1 (not at all) to 5 (a great deal). Responses 1-3 and 4-5 were grouped. Three sets of questions and response options asked: "What issues do you think TD can address in NC?", "In what ways do you think TD could be used in NC?", and "There are many challenges

for implementing and delivering TD services in NC. Which one do you think should be addressed first?"

### **Statistical analysis**

The analytical dataset was limited to information from respondents with pre- and post-survey ID matches. The analysis included descriptive statistics for each variable, comparison of frequency distributions for categorical variables, and exact McNemar's matched pair test to compare pre- and post-Summit proportions of the participants' responses to the surveys. Multi-level responses were converted to binary responses for comparison due to the small sample size. For the question regarding the challenge to be addressed first, the comparison was whether a choice was selected or not. Each of the pre- and post-survey questions were analyzed separately; first ignoring whether or not the participants were involved in patient care (practicing clinicians) or had other roles. Subsequent analyses were performed to determine whether results differed by the "practicing clinician" (yes/no) classification. The 95% confidence intervals associated with each difference (increase) in proportion were reported. A sensitivity analysis was conducted to assess whether conclusions changed if students were classified as practicing clinicians or not. A 5% statistical significance level was used for the comparison of the proportions. SAS version 9.4 (TS1M1 SAS Institute Inc.; Cary, NC, USA) was used for the data analyses.

## **Results**

The pre-Summit and post-Summit response rates were 75.3% and 70.1% respectively. However, not all of the pre- and post-Summit surveys (62.7%, n=42) could be matched, as not everyone completed both surveys. Of those who completed the post-Summit surveys, not all of the participants provided consistent responses to the five questions needed to create their unique identifier. The results assessing pre- and post-survey change are based on 42 participants, including eight students. A comparison of the characteristics of these 42 and all 58 who completed the pre-Summit survey was performed and the frequency distributions were found to be very similar (Table I).

### **Participant characteristics**

Of the participants with matched pre-post data (n=42), about half, (47.6%) reported that their primary role was in administration, 21.4% teaching and mentoring, 12.0% patient care. Students comprised 19.0% of the data set. Of the participants who were not students, 32.0% were currently practicing clinicians; others were educators or administrators.

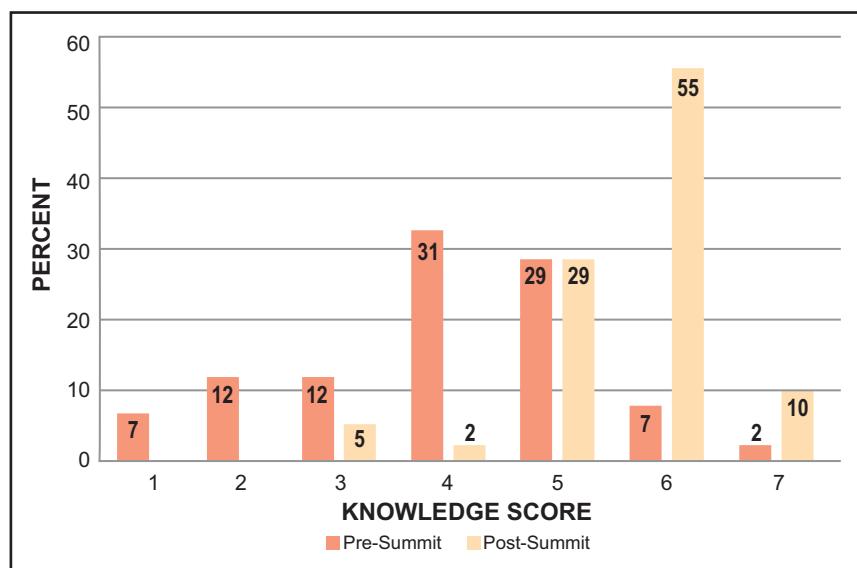
**Table I. Participant characteristics and selected pre-Summit survey response proportions**

Characteristic or Survey Item	Pre-Summit Respondents (n=58) n (%)	Matched Datasets(n=42) n (%)
Primary Role		
Administration	28 (48.3)	20 (47.6)
Teaching and Mentoring	12 (20.7)	9 (21.4)
Patient Care	8 (13.8)	5 (12.0)
Student	10 (17.2)	8 (19.0)
Practicing Clinician (excluding students)	17 (35.2)	11 (32.4)
Rating of extent of current overall knowledge about TD*	21 (36.2)	16 (38.1)
Rating of extent of current knowledge about NC telemedicine policies for Medicaid reimbursement*	8 (13.8)	7 (16.7)
Rating of extent to which TD should be developed in NC**	47 (81.0)	33 (78.6)
Rating of extent of dental hygienists' role in delivering TD in NC**	48 (82.8)	35 (83.3)
First challenge to address for implementing and delivering TD services in NC: State dental practice act or not	22 (37.9)	14 (33.3)

\* Rating of 5-7 on scale from 1 (no knowledge) to 7 (very knowledgeable);

\*\* Rating of 4-5 on scale from 1 (not at all) to 5 (a great deal).

**Figure 1. Frequency distribution of responses to item: Please rate the extent of your current overall knowledge about TD on a scale of 1 to 7 (1=no knowledge, 7=very knowledgeable) (n=42)**



### *Changes in self-reported knowledge and attitudes*

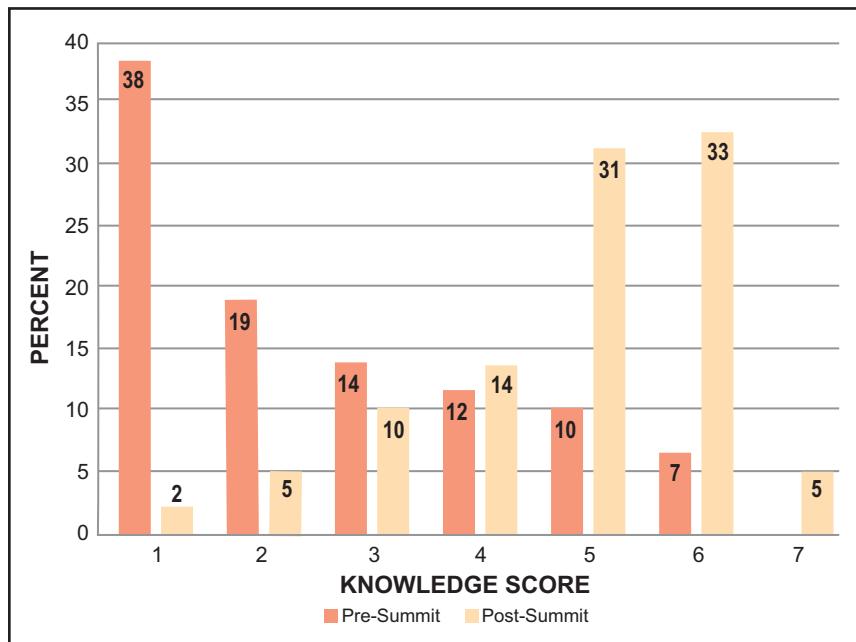
Overall, self-reported knowledge about TD significantly increased pre- (38.1%) to post-Summit (92.9%) as indicated by respondents providing a knowledge score of 5-7,  $p<0.001$  (Figure 1, Table I). There was also a significant increase in knowledge about NC telemedicine policies for Medicaid reimbursement; 16.7% of participants provided responses from 5-7 pre-Summit, increasing to 69.1% post-Summit,  $p<0.001$  (Figure 2, Table II). The majority, 78.6%, indicated in the pre-Summit survey that TD should be developed in NC, providing scores of 4-5; the proportion increased to 95.2% post-Summit,  $p=0.065$  (Figure 3, Table II). Responses regarding the extent to which dental hygienists should have a role in the delivery of services in NC, was high at both time points, (83.3% pre- and 88.1% post-), thus the change was not significant,  $p=0.727$ .

### *Teledentistry issues and utilization*

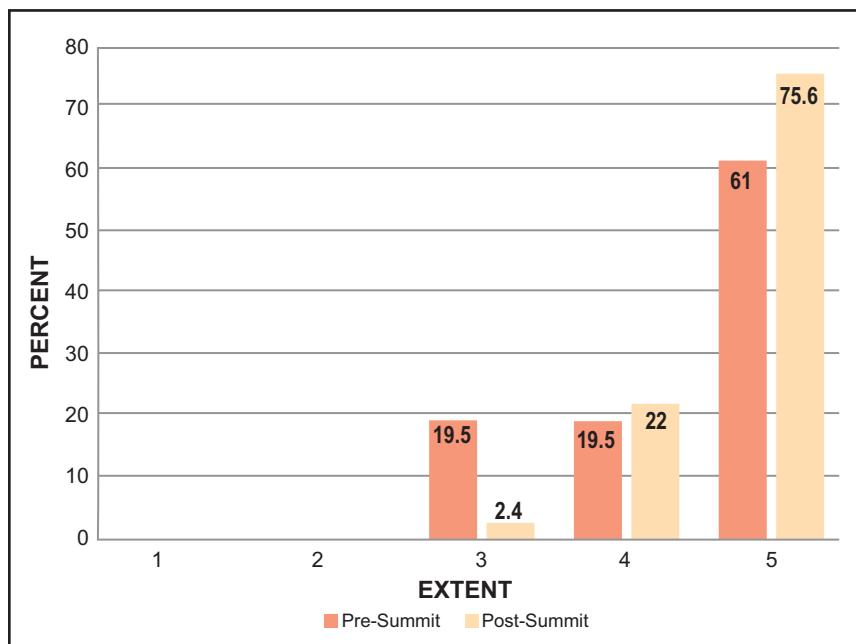
Responses to the nine issues that TD can address in NC were favorable at both time points. Pre-Summit, all participants responded "yes" to seven items: increasing access to care and patient outreach, efficient use of clinician's and patient's time, improving oral health in rural NC, facilitating consultation with health care specialists, and reducing patients' travel costs. Almost all respondents agreed with the remaining two items; TD can increase reimbursement to dentists by provision of more services (97.6%) and TD can increase the number of dentists who are prepared to treat patients in NC's rural/underserved communities (85.7%). There were minor variations in the responses post-Summit, with 100.0% responding "yes" to four of the same issues, and 88.1% to 97.6% responding "yes" to the remaining issues.

Participants were asked about seven possible ways that TD could be used in NC (Table III). Pre-Summit, 92.9% responded that it could be used in the following ways: 1) synchronous use such as for real-time patient consultations, 2) asynchronous use called, "store and forward" to send patient information for specialty

**Figure 2. Frequency distribution of responses to item: Please rate the extent of your current knowledge about NC telemedicine policies for Medicaid reimbursement on a scale of 1 to 7 (1=no knowledge, 7=very knowledgeable) (n=42)**



**Figure 3. Frequency distribution of responses to item: Please rank the extent to which TD should be developed in NC on a scale of 1 to 5 (1=not at all, 5=a great deal) (n=42)**



consultation, and 3) patient education. A majority, 88.1%, indicated that it could be used for mHealth (mobile health such as smart phones/iPads for monitoring patient health) or oral health screening (i.e., schools, nursing homes, prisons) and for continuing education (85.7%). The greatest response

change was for Remote Patient Monitoring (RPM) such as for patients in an intensive care unit in a distant location; pre-Summit (71.4%) and post-Summit (95.2%). For the remaining items, post-Summit responses ranged from 78.6% to 100.0%. Asynchronous use was the only item where the proportion of affirmative responses declined, from 92.3% to 78.6%, reflecting current statutory regulations.

### Challenges

Participants were given a list of seven challenges for implementing and delivering TD services in NC and asked which one should be addressed first (Table IV). Both pre- and post-Summit, the most frequent challenge reported was the “state practice act requiring direct supervision of dental hygienists, limiting their TD use in community settings.” This challenge was selected by 33.3% (pre-Summit) and 59.5% (post-Summit), a significant increase compared to all other responses,  $p=0.013$  (Table II, IV). Because respondents were asked to select one challenge, the increase in the state practice act category was balanced by decreases in some of the other categories such as reimbursement issues. Further examination was performed on whether the choice of state practice act regarding dental hygiene varied between those self-identified as practicing clinicians vs other professional roles. The pre-post change in proportions was a little larger for practicing clinicians than others, but was not significant for either group,  $p=0.063$  (95% CI: 0.05, 0.72) and  $p=0.147$  (95% CI: 0.30, 0.63), respectively.

### Student classification sensitivity analysis

Students could have self-identified as practicing clinicians or not. Students were not asked to indicate their year of enrollment in their respective programs. The sensitivity analysis compared findings as if all the students had been classified as practicing clinicians or not, and indicated that the conclusions did not change regardless of how the students were classified.

### Discussion

Dental hygienists are powerful advocates for the community and are vastly underutilized when addressing access to care needs. Teledentistry is a model that can incorporate utilization

**Table II. Proportional differences in pre- and post- survey item agreement between the respondents (n=42)**

Survey Items	Est Diff* (%)	SE*	95% CI*	p-value*
Participants' rating of extent of current overall knowledge about TD	54.8	0.11	(0.33,0.76)	<0.001
Participants' rating of extent of current knowledge about NC telemedicine policies for Medicaid reimbursement	52.4	0.11	(0.31, 0.74)	<0.001
Participants' rating of extent to which TD should be developed in NC	16.7	0.08	(0.01,0.32)	0.065
Participants' rating of extent of dental hygienists' role in delivering TD in NC	4.8	0.07	(-0.09,0.19)	0.727
"State practice act requiring direct supervision of dental hygienists, limiting their TD use in community settings" selected as first challenge to address	26.2	0.10	(0.07,0.46)	0.013

\*Estimated difference between pre-and-post proportions

SE: Asymptotic standard error CI: 95% Confidence Interval p-value: exact McNemar's p-value

**Table III. Proportion of respondents indicating the ways TD could be utilized in NC (n=42)**

In what ways do you think teledentistry could be used in NC? "Yes" responses	Pre-Summit n (%)	Post-Summit n (%)
Synchronous use such as for real-time patient consultations	39 (92.9%)	42 (100.0%)
Asynchronous use called, "store and forward" to send patient information for specialty consultation	39 (92.9%)	33 (78.6%)
Patient education	39 (92.9%)	40 (95.2%)
mHealth (mobile health such as smart phones/iPads for monitoring patient health)	37 (88.1%)	34 (81.0%)
Oral health screening (i.e., schools, nursing homes, prisons)	37 (88.1%)	39 (92.9%)
Continuing education	36 (85.7%)	39 (92.9%)
Remote Patient Monitoring (RPM) such as for patients in an ICU in a distant location	30 (71.4%)	40 (95.2%)

of dental hygienists to screen, counsel, and refer; addressing both preventive needs and connection to a dental care provider. A major finding of this study was the significant increase in identifying the NC State Practice Act as the first challenge to be addressed to implement TD among the Summit respondents. The scope of practice for dental hygienists in NC is one of the most restrictive in the nation, requiring direct, on-site supervision of dental hygienists and a prior dentist examination.<sup>22</sup> Unique circumstances can allow for indirect supervision of dental hygienists, but a prior examination by a dentist is always required.

Teledentistry can provide an alternative method to the current on-site clinical examination process.

The findings provide impetus for working with the legislature, to make modifications, so that dental hygienists can play a key role in the implementation of TD. The virtual dental home model in California is a successful example of dental hygienists being a key part of the TD team.<sup>23</sup>

In a TD literature review that included evaluation of clinical outcomes and costs, Daniel et al., found that different types of oral health care personnel have been used to conduct remote clinical screenings and capture intraoral images. The authors discussed that "expanding the roles of dental hygienists and removing practice restrictions would increase the number of oral health care providers who could perform screenings, care and referrals using TD."<sup>24</sup> In a Tennessee study comparing decayed and filled surface (DFS) scores of 4-7-year-old children obtained by a dentist and dental hygienist using clinical methods versus a dentist and dental hygienist using TD (intraoral photographs) methods, found that the DFS scores between the two groups and methods were not significantly different,  $p > 0.10$ .<sup>25</sup> Studies comparing larger numbers of dentists' diagnoses via TD and hygienists' screening assessments may be needed.

A key barrier to the implementation of TD practices has been found in the restrictive dental practice acts that states, such as NC, place on the roles and functions of dental hygienists. Teledentistry can be used as an effective tool for conducting a remote consultation between a patient

**Table IV. Proportion of respondents indicating the first challenge to be addressed to implement TD in NC (n=42)**

There are many challenges for implementing and delivering teledentistry services in NC. Which one do you think should be addressed first?	Pre-Summit n (%)	Post-Summit n (%)
State practice act requiring direct supervision of dental hygienists, limiting their teledentistry use in community settings	14 (33.3%)	25 (59.5%)
Reimbursement Issues	8 (19.0%)	4 (9.5%)
Lack of education/continuing education for using TD	7 (16.7%)	6 (14.3%)
Telemedicine Medicaid policies requiring that consultation takes place by two-way real-time interactive audio and video telecommunication systems	6 (14.3%)	3 (7.1%)
Costs of purchasing, installing and maintaining technology	3 (7.1%)	0 (0.0%)
Difficulties scheduling synchronous TD services at distant sites	1 (2.4%)	1 (2.4%)
No Response	1 (2.4%)	1 (2.4%)
Other (Please Specify)	2 (4.8%)	2 (4.8%)

at the originating site and a consulting provider at the distant site. Its benefits lie in the convenience for both patient and provider, improving access to care for those who reside in rural and underserved communities, avoidance of having to travel considerable distances and the knowledgeable triaging of patient referrals.

A 2014 TD survey of Australian dental practitioners supports the findings of this study. Authors expressed agreement with its advantages and usefulness for patients, especially those in rural locations, and aspects of dental practice including communication with patients, colleagues and facilitation of referrals. Concerns were expressed regarding data security, patient consent and privacy, equipment costs and technical compatibility,<sup>26</sup> indicating mutual issues to address in order for TD to advance globally. A systematic review of multi-national barriers to adopting telemedicine also identified similar barriers for TD, in addition to high cost, lack of reimbursement, and public policy barriers regarding state provider licensing and inter-state commerce restrictions in the United States.<sup>27</sup>

This study had limitations. Since the Summit participants were invited and agreed to attend an all-day event, they may have been more likely to be interested in learning about the topic and predisposed to having more favorable attitudes towards TD than individuals who

were not invited to attend. Regardless, initial self-reported TD knowledge was relatively low among the invitees. While these results do not reflect TD knowledge of NC residents or clinicians at large, it would also be likely to be low. To advance TD, more extensive communication and education to both lay and clinician audiences will be necessary.

Not all attendees completed the post-Summit survey or remembered the responses they provided on the pre-survey to create a code that could be used for the identifier to match the post-survey. Thus, the number of matched pairs to assess differences before and after the Summit was limited to a subset of the total number of participants. However, the pre-Summit survey distributions of characteristics for all respondents (n=58) were similar to those used in the analytical matched sample (n=42). The number of dental hygienists or dental hygiene students who attended the Summit was small (n=2). It is not known if they completed the survey. While the dental hygienist perspectives regarding TD were of interest, in order to maintain confidentiality, the responses were not segregated.

## Conclusions

Teledentistry Summit participants' self-reported knowledge was high following the event and attitudes were found to be favorable for moving forward with TD in NC. Respondents indicated that TD should be developed in NC and could address many issues to improve patient care. The majority felt dental hygienists should have a role in TD and that the state practice act governing their scope of practice was the first challenge that should be addressed.

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## References

1. Khan SA and Omar H. Teledentistry in practice: literature review. *Telemed J E Health*. 2013 Jul;19(7):565-7.
2. ATA. Telemedicine glossary [Internet]. Arlington: ATA; c2018 [cited 2019 July 12]. Available from: <https://www.americanamed.org/resource/reference/>
3. Chen JW, Hobdell MH, Dunn K, et al. Teledentistry and its use in dental education. *J Am Dent Assoc*. 2003 Mar;134(3):342-6.
4. Rocca MA, Kudryk VL, Pajak JC, Morris T. The evolution of a teledentistry system within the Department of Defense. *Proceedings. AMIA Symposium*. 1999;921-4.
5. Shirolkar R, Ruparelia KP, More C, Ruparelia P. Teledentistry: an art and science of healing. *J Indian Acad Oral Med Radiol*. 2011;23(2):108-11.
6. Daniel SJ and Kumar S. Teledentistry: a key component in access to care. *J Evid Based Dent Pract*. 2014 Jun14; Suppl:201-8.
7. Glassman P, Harrington M, Mertz E, Namakian M. The virtual dental home: implications for policy and strategy. *J Calif Dent Assoc*. 2012 Oct 22;40(7):605-11.
8. Estai M, Bunt S, Kanagasingam Y, et al. Diagnostic accuracy of teledentistry in the detection of dental caries: a systematic review. *J Evid Based Dent Pract*. 2016 Sep 7;16(3):161-72.
9. Alabdullah JH and Daniel SJ. A systematic review of the validity of teledentistry. *Telemed J E Health*. 2018 Jan 5;24(8):639-48.
10. Mandall NA, O'Brian KD, Brady J, et al. Teledentistry for screening new patient orthodontic referrals. Part 1: a randomized controlled trial. *Br Dent J*. 2005 Nov 26;199(10):659-62.
11. Queyroux A, Saricassapian B, Herzog D, et al. Accuracy of teledentistry for diagnosing dental pathology using direct examination as a gold standard: results of the tel-e-dent study of older adults living in nursing homes. *J Am Med Dir Assoc*. 2017 Feb 22;18(6):528-32.
12. Kopycka-Kedzierski DT, McLaren SW, Billings RJ. Advancement of teledentistry at the University of Rochester's Eastman Institute for Oral Health. *Health Aff (Millwood)* 2018 Dec;37(12):1960-6.
13. Friction J, Chen H. Using teledentistry to improve access to dental care for the underserved. *Dent Clin North Am*. 2009 Jul;53(3):537-48.
14. Berndt J, Leone P, King G. Using teledentistry to provide interceptive orthodontic services to disadvantaged children. *Am J Orthod Dentofacial Orthop*. 2008 Nov;134(5):700-6.
15. Carrard VC, Roxo Gonçalves M, Rodriguez Strey J, et al. Telediagnosis of oral lesions in primary care: the EstomatoNet Program. *Oral Dis*. 2018 June 7;24(6):1012-9.
16. Estai M, Kanagasingam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. *J Telemed Telecare*. 2018 Apr;24(3):147-56.
17. United States Census Bureau. QuickFacts North Carolina population estimates, July 1, 2019. [Internet]. Suitland: U.S. Department of Commerce. 2020 [cited 2020 June 4]. Available from: <https://www.census.gov/quickfacts/NC>
18. Kaiser Family Foundation; Dental care health professional shortage areas (HPSAs) as of September 30, 2019 [Internet]. Washington, DC: Kaiser Family Foundation; c2020 [cited 2020 June 4]. Available from: <https://www.kff.org/state-category/providers-service-use/>
19. Barnett ML, Ray KN, Souza J, Mehrotra A. Trends in telemedicine use in a large commercially insured population, 2005-2017. *JAMA* 2018 Nov 27; 320(20):2147-9.

20. UNC Medical Center. 24/7 Virtual Urgent Care [Internet]. Chapel Hill: UNC Health Care; c2020. [cited 2020 June 4]. Available from <https://www.uncmcdental.org/uncmc/care-treatment/urgent-care/24-7-virtual-urgent-care/>
21. University of the Pacific. Virtual dental home system of care [Internet]. San Francisco: Arthur A. Dugoni School of Dentistry; c2020 [cited 2020 June 4] Available from: <https://dental.pacific.edu/departments-and-groups/pacific-center-for-special-care/innovations-center/virtual-dental-home-system-of-care>
22. Oral Health Workforce Research Center. Variation in dental hygiene scope of practice by state [Internet]. Albany: SUNY School of Public Health; c2015. [updated 2019 January; cited 2020 June 4] Available from: <http://www.oralhealthworkforce.org/resources/variation-in-dental-hygiene-scope-of-practice-by-state/>
23. Glassman P, Harrington M, Mertz E, Namakian M. The virtual dental home: implications for policy and strategy. J Calif Dent Assoc. 2012 Jul 40(7):605-11.
24. Daniel S, Wu L, Kumar S. Teledentistry: a systematic review of clinical outcomes, utilization and costs. J Dent Hyg. 2013 Dec;87:345–52.
25. Daniel SJ, Kumar S. Comparison of dental hygienists and dentists: clinical and teledentistry identification of dental caries in children. Int J Dent Hyg. 2017 Nov;15(4):e143-e148.
26. Estai M, Kruger E, Tennant M. Perceptions of Australian dental practitioners about using telemedicine in dental practice. Br Dent J. 2016 Jan 15; 220(1):25-9.
27. Scott Kruse C, Karem P, Shifflett K, et al. Evaluating barriers to adopting telemedicine worldwide: a systematic review. J Telemed Telecare. 2018 Jan;24(1):4-12.

## Mental Health and Self-Care Practices Among Dental Hygienists

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### Abstract

**Purpose:** Occupational stress and burn-out among dental hygienists may produce a decrease in overall mental health and well-being. The purpose of this study was to determine prevalence of mental health concerns as well as perceived stressors and self-care strategies among dental hygienists in Oregon.

**Methods:** Dental hygienists belonging to the Oregon Dental Hygienists' Association were invited to participate in an electronic survey. The validated and pilot tested-survey consisted of 28 items that addressed experiences with stress, mental health issues and coping mechanisms. Descriptive and inferential statistics were used to analyze the data.

**Results:** Of the email invitations that were successfully delivered ( $n=251$ ), 83 dental hygienists volunteered to participate ( $n=83$ ), for a 33% response rate. Difficulty maintaining work-life balance (35%,  $n=28$ ), dysfunctional work teams (34%,  $n=28$ ), and not enough time in the work schedule (65%,  $n=54$ ) were the most common stressors. Respondents who worked  $\geq 20$  hours per week were more likely to attribute their daily stress primarily or entirely to work ( $p=0.009$ ). Self-care methods included exercise, quiet time, spending time with loved ones, and self-care activities. Only 21% of respondents ( $n=17$ ) reported that they received information or training on stress management and or burn-out in as part of their dental hygiene education.

**Conclusion:** Symptoms linked to depression and anxiety are common among dental hygienists in Oregon. Stress management education and training should be incorporated in dental hygiene educational programs to prepare graduates to effectively manage the stressors that may lead to burn-out. Additional research should be conducted on a national level to gain a more representative sample.

**Key words:** dental hygienist, anxiety, depression, mental health, burn-out, self-care

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### Introduction

Mental health and overall well-being have long been recognized in the United States (US) as areas of concern, as evidenced by the National Mental Health Act, signed into law in 1946.<sup>1</sup> Recent estimates from the National Institute of Mental Health, indicate that approximately 19% of adults in the U.S. have experienced anxiety, and about 16.2 million adults have had one or more major depressive episodes at some point in their life.<sup>2</sup> Anxiety, like many mental health disorders, can interfere with daily activities such as work performance, school, and personal relationships.<sup>3</sup> In regards to work performance, one major concern is professional burn-out. Professional burn-out is characterized by emotional and physical exhaustion,

detachment from work, and feelings of professional loneliness.<sup>4</sup> When a person experiences an overload of chronic stress that is work-related, burn-out is frequently the end result.<sup>4</sup> Professional burn-out is a concerning factor among many professions and has been shown to have a greater impact on individuals who work closely with others.<sup>4</sup> Because the dental team works closely together to care for patients, dental professionals are at risk of experiencing burn-out.<sup>4</sup>

Recently, there has been growing interest and awareness of mental health as an essential component of overall health. However, there has been limited research on this topic among dental health professionals. The first study regarding

the mental health and well-being of dental hygienists was conducted 20 years ago by Deckard and Rountree and focused specifically on burn-out.<sup>5</sup> Respondents reported feeling emotionally exhausted, experienced high levels of depersonalization, and had negative feelings about their daily tasks in general.<sup>5</sup> More current research has identified additional factors for occupational stress and negativity within the profession, with lack of autonomy and decision making in the workplace common reasons.<sup>6</sup> Individuals with lower levels of autonomy, who struggled to identify their professional roles, were shown to experience the most burn-out.<sup>6</sup> Another common theme in the literature has been the need to incorporate stress management courses within dental hygiene programs.<sup>4,6</sup> By addressing stress management as part of the dental hygiene curriculum, new graduates can have a better understanding of how they like to work, and this knowledge may help to reduce the likelihood of experiencing burn-out.<sup>4</sup> Stress assessment tools, policies, and open communication are methods currently suggested in the literature for stress reduction among dental professionals.<sup>4</sup>

There is an overall lack of research pertaining to the mental health of dental hygienists in the US, however an number of studies have been conducted outside of the US.<sup>6</sup> In a study pertaining to job satisfaction among Dutch dental hygienists, those who held a four-year degree in the Netherlands had more autonomy and felt fewer symptoms associated with stress than those with a two-year degree.<sup>6</sup> Dental hygienists in Canada reported lack of job satisfaction and stress stemmed from low pay and insufficient benefits.<sup>6</sup> These studies suggest dental hygienists in different areas of the world experience various stressors related to their scope of practice.<sup>6</sup> In addition to a lack of autonomy, existing literature identifies other stressors that contribute to low job satisfaction. These stressors include demanding schedules and patients, lack of time, and musculoskeletal complaints.<sup>7,8</sup> Musculoskeletal disorders are a common issue among the dental hygiene profession and can lead to a decrease in clinical working hours.<sup>7</sup> Sick leave among dental hygienists has been shown to be significantly higher among professionals with musculoskeletal complaints.<sup>7</sup>

Organizational work factors and work-family overload are additional contributing stressors that can lead to a greater prevalence of reduced mental health and well-being.<sup>8</sup> Elevated mental health and well-being were associated with a high perception of personal mastery, active leisure, and high levels of management support.<sup>8</sup> Similar research has been conducted on stress, anxiety, and burn-out of dentists.<sup>9</sup> These studies conclude that due to the nature of clinical practice, general dentists and those in the field of dentistry are likely to experience burn-out in their profession.<sup>9</sup>

While there is limited research available regarding burn-out of dental professionals, there are multiple studies on burn-out within other health professions. A study conducted on the incidence of burn-out in US physicians revealed almost half of the studied physicians reported feeling symptoms of burn-out.<sup>10</sup> Burn-out was described as feelings characterized by loss of enthusiasm at work, feeling cynical, and having a low sense of personal accomplishment.<sup>10,11</sup> Long-term effects of burn-out experienced by physicians can lead to adverse effects towards patient care.<sup>10</sup> Nurses and other medical staff members experience similar feelings of low job satisfaction and burn-out. In a study of hospital nurses working in the US, the majority reported experiencing symptoms of burn-out.<sup>12</sup> When staff members are experiencing burn-out, they are typically not performing to the best of their abilities. This diminished level of job performance can place added stress on the doctor and supporting staff they are working with, decreasing the overall quality of care being provided.<sup>11</sup>

The majority of current research on mental health and well-being of dental hygienists has been limited focusing on ergonomics and musculoskeletal issues associated with dental hygiene occupational stress.<sup>7,8</sup> Existing research suggests occupational stress and burn-out among dental hygienists may produce a decline in overall mental health and well-being, increase physical strain, and may lead to chronic disease over time.<sup>4,9</sup> However, little is known about the prevalence of mental health conditions and self-care strategies among dental hygienists. More in-depth investigation of the incidence, risk factors, and resources available is needed, in order to determine better coping methods and ways to avoid job related burn-out for dental hygienists.<sup>4</sup> The purpose of this study was to gather data regarding the mental health status, self-care practices, and stress triggers among dental hygienists.

## Methods

This cross-sectional survey study of dental hygienists in the state of Oregon was deemed exempt by the Pacific University Institutional Review Board. The survey instrument was developed by the authors and was pilot tested by 3 dental hygienists and 1 mental health professional, and revisions were made based on feedback. The final survey instrument consisted of 28 items which addressed the following areas: participants' experiences with symptoms of depression and anxiety, perception of stress, support system, consultation with a mental health professional, strategies for stress relief, work benefits and incentives surrounding mental health and wellbeing, work history, and demographics. The online survey was developed using Qualtrics software (Qualtrics;

Provo, UT) and administered via email to members of the Oregon Dental Hygienists Association (ODHA). A total of 251 invitations were successfully delivered to the ODHA membership listserv.

Descriptive and inferential statistics were computed using SPSS version 23 (IBM; Armonk, NY). Inferential analyses (Fisher's Exact Tests) were conducted to determine whether perceptions of stress and stress management practices varied based on the total number of hours worked per week, type of dental hygiene position, and clinical practice type. The level of statistical significance was set at 0.05.

## Results

A total of 83 ODHA member dental hygienists agreed to participate for a response rate of 33%. Ninety-five percent (n=79) of the population surveyed worked in general dentistry, 5% (n=4) in periodontics, 1% (n=1) in pediatric dentistry, and 10% (n=8) in a public health setting. Regarding the number of hours worked per week, 45%, worked 31-40 hours per week (n=38), while 40% (n=33) worked on average, less than 30 hours per week.

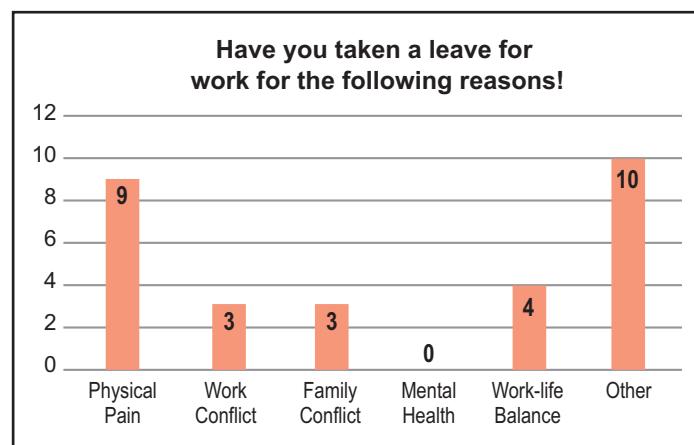
Respondents were asked to rate their average daily stress level in 3 categories; low, moderate and high. Sixteen percent of respondents (n=13) reported having high daily stress levels, while over half (65%, n=54) reported having a moderate daily stress level and 19% reported low daily stress (n=16). Participants were also asked to what extent they felt their daily stress levels were due to work. Eleven percent (n=9) felt their stress was entirely due to work, while 57% (n=46) felt it was primarily due to work, 28% (n=25) felt it was somewhat due to work, and 4% (n=3) felt it was not related to work. Fisher's Exact tests revealed that dental hygienists who worked  $\geq 20$  hours per week were more likely to attribute their daily stress primarily or entirely to work ( $p=0.009$ ). Participants were also asked to rate how well they were managing their daily stress levels. Seventeen percent (n=14) indicated extremely well, 60% (n=50) somewhat well, 10% (n=8) neutral, and 13% (n=11) somewhat poorly. Fisher's Exact tests revealed that the number of hours worked per week was directly related to the perception of managing stress, indicating that participants who worked more hours per week felt less able to manage their stress ( $p=0.006$ ).

Thirty-eight percent of respondents (n=32) reported on their reason(s) for taking leave from work (Figure 1). Of these respondents, 11% percent (n=9) responded that their work leave

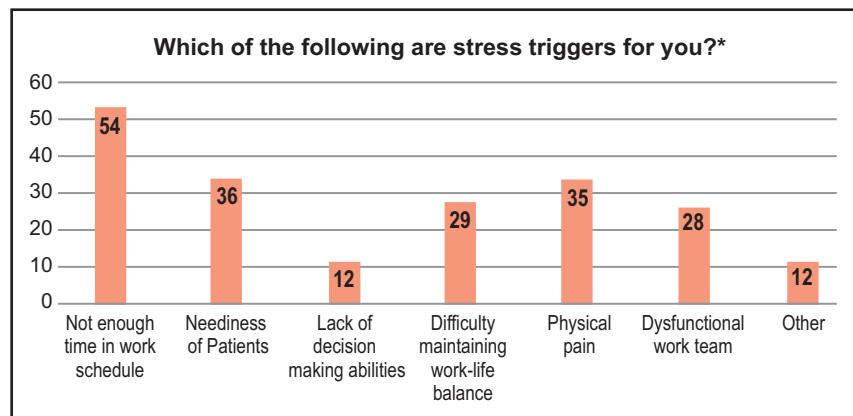
was due to physical pain, while 12% (n=10) reported work leave was taken for unspecified specified reasons. None of the respondents indicated mental health as a reason for taking leave from work. When asked to select what most often triggered stress among those who responded, 35% (n=29) of the participants stated difficulty maintaining a work-life balance, while 34% (n=28) mentioned a dysfunctional work team as a stress trigger, and 65% (n=54) indicated not enough time in the work schedule as a stress trigger (Figure 2).

When the participants were asked what type of support system they had outside of their work environment, a majority (92%, n=76) identified their family while three-fourths (78%, n=65) stated that their friends served as their support system. Additionally, 8% (n=16) of respondents sought support outside of work with a mental health professional and 8% (n=16) sought support with a community organization. About one third (36%, n=30) of the participants reported that their employer offered incentives to help with stress reduction. Examples of employer provided incentives included team building opportunities (17%, n=14), travel

**Figure 1. Reasons for taking leave from work (n=32)**



**Figure 2. Stress triggers (n=83)**



\*Choose all that apply

opportunities (6%, n=5), and other unspecified incentives (8%, n=7). Eight percent (n=7) found these incentives to be very beneficial, 11% (n=9) found the incentives somewhat beneficial, and 4% (n=3) stated they had neutral feelings about how helpful their office incentives contributed to their mental health. None of the participants indicated that the incentives were detrimental to their mental health and well-being.

Respondents were asked to identify symptoms of depression and anxiety experienced over multiple consecutive days. These conditions were not labeled as symptoms of anxiety and depression on the survey. Data revealed the most common symptoms of depression were anger, irritability, and frustration (n=44), appetite and weight changes (n=26), and difficulty thinking, concentrating and making decisions (n=25) (Figure 3). Data identified symptoms of anxiety were trouble sleeping (n=45) and feeling nervous, restless, or tense (n=42). Nineteen percent of the respondents indicated that they had consulted a mental health professional about their mental health concerns (Figure 4).

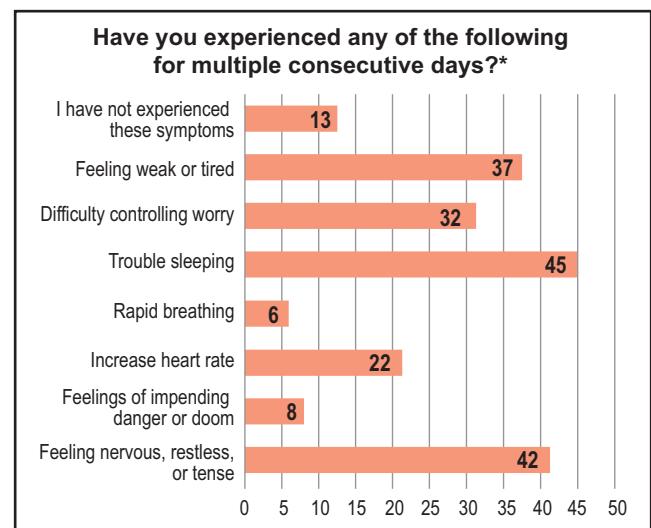
**Figure 3. Symptoms of depression experienced by participants (n=83)**



\*Choose all that apply

The majority of respondents reported that having more time to engage in self-care activities (71%, n=59) and improved working conditions (57%, n=47) would be the most successful stress reduction interventions. Other responses included additional education (14%, n=12), and seeking a new profession (17%, n=14). When the respondents were prompted to identify how they learned to manage stress, over one third (37%, n=31) identified learning through self-help books and instructions and a little less than one-third (31%, n=26) reported learning stress management through other unspecified methods. Only 21% (n=17) reported receiving information or training on stress management and or burn-out during their dental hygiene education (Figure 5).

**Figure 4. Symptoms of anxiety (n=83)**



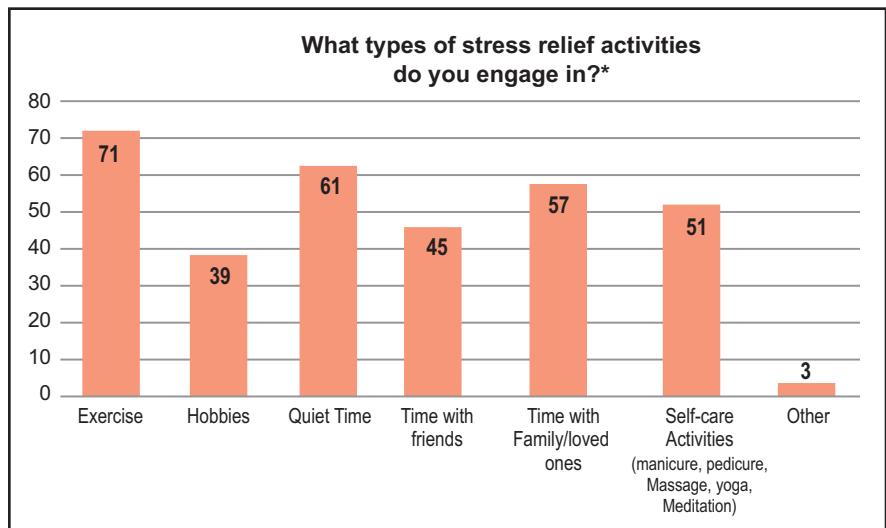
\*Choose all that apply

When prompted to identify all of the various types of stress relief activities the respondents engaged in, 85% (n=71) reported exercise, 73% (n=61) quiet time, 67% (n=57) spending time with loved ones, 62% (n=51) self-care activities, and 4% (n=3) other (Figure 6). Examples of self-care activities included manicure, pedicure, massage, meditation, and yoga. Respondents were asked how often they engaged in stress reduction activities, both on the average, and during times of significant stress. Rates of participation in stress-relief activities were shown to be lower during times of significant stress, with the majority 39% (n=33) stating 1-2 days per week, followed by 27% (n=22) who selected 3-4 days per week. In regards to the average frequency of stress-relief activities, 26% (n=21) selected 1-2 days per week, 42% (n=34) selected 3-4 days per week, 21% (n=17) selected 5-6 days per week, and 11% (n=9) selected daily.

**Figure 5. Sources of stress management skills (n=83)**



**Figure 6. Stress-relief activities (n=83)**



\*Choose all that apply

## Discussion

Results from this study support findings from other studies in the existing pool of literature. Nearly half of the participants experienced symptoms of nervousness, tiredness, restlessness, trouble sleeping, anger, and irritability for multiple consecutive days. Similar symptoms have been noted in general dentists as well.<sup>9</sup> Of the study participants, over half had not consulted with a mental health professional regarding mental health concerns. In addition, over half of the respondents reported moderate levels of daily stress, with lack of time in schedule, physical pain, and the neediness of patients the most commonly identified triggers. These findings are relevant as they identify specific stress symptoms and triggers. Data suggest that a large portion of practicing dental hygienists experience work related stressors that may contribute to burn-out.

These findings have importance for practicing dental hygienists, because they shed light on the prevalence and nature of decreased mental health and well-being within dentistry. Members of the profession should understand that increases in symptoms such as mental fatigue, impatience, headache, and anxiety can contribute to more frequent leaves from work and to an overall decrease in longevity of clinical career.<sup>7</sup> In addition to expanding the research within this area, this study identified methods of stress management currently utilized by practicing dental hygienists. It is important that stress triggers and symptoms be identified to help prevent future negative mental health disorders and burn-out within the dental hygiene profession.

The majority of participants in this study did not receive training during their dental hygiene education regarding stress management. While data suggests stressors and poor mental health are prevalent in practice, there is a lack of curricular content dedicated to the subject within formal education programs. Results from this study supported the existing literature regarding a need for dental hygiene schools to implement stress management courses in their curriculum.<sup>4,6,8</sup> Other studies have also suggested that incorporating stress management into dental hygiene education would provide new practitioners

the opportunity to reflect on their ideal work environment, resulting in decreased work-related stress.<sup>4</sup> However, education on stress management is not currently a required element according to the standards set forth by the Commission on Dental Accreditation (CODA).<sup>13</sup> While it is not required, the addition of a stress management course or related content could benefit students by preparing them to deal with stressors that could lead to burn-out in addition to improving conflict resolution and communication skills.<sup>4</sup>

Participants reported learning to unwind, including participating in leisure and self-care activities, helped with managing work related stress. Previous research has shown that stressors experienced by practicing dental hygienists were related to lack of time in the schedule and musculoskeletal complaints.<sup>4,7,8</sup> Findings from this study support previous research showing that dental hygienists identify a lack of time in their schedule as a major contributor to stress in the work place. Physical pain was an additional reason for taking time off from work and the second most commonly experienced stressor among the participants in this study.

Burn-out is universal among all health care providers and has been shown to negatively affect the care that patients receive.<sup>14</sup> Research has shown that when the health and work life of providers improves, better patient care follows.<sup>14</sup> Physicians experiencing burn-out have been shown to have less empathy for their patients, deviate from treatment plans, and prescribe unnecessary medications.<sup>15,16,17</sup> Burn-out has been shown to be particularly prevalent among professions with a high number of interactions with other people<sup>18</sup> making it reasonable to expect to see a higher level of burn-out among dental hygienists.

Previous research focusing on burn-out and mental well-being of dental hygienists has shown that lack autonomy was one of the largest stressors leading to symptoms of stress, anxiety, depression, and burn-out among dental hygienists.<sup>4,6</sup> While this study did not specifically inquire about lack of

autonomy, lack of decision making was an included item. A relatively small proportion of respondents (14%, n=12) reported that lack of decision-making ability was a stressor. This inconsistency with existing literature could be a result of Oregon's progressive practice act and broad scope of practice for dental hygienists.

This study had limitations. The sample population was limited to the 251 members of the ODHA and does not reflect dental hygienists outside of the state of Oregon. While a 33% response rate is acceptable for survey research, a larger sample size would increase the generalizability of the results. There is also the potential for non-response bias due to the sample population. Participants were all members of the ODHA and may not be representative of the entire population of dental hygienists. Future research on this topic should include a more representative sample of all dental hygienists by expanding the survey nationwide. A national survey would also allow for a comparison between practice acts with differing responsibilities and levels of autonomy. A larger survey sample would add knowledge regarding the impact of the dental industry on mental health and identify areas where changes in education and professional practice could be made.

## Conclusion

Dental hygienists in Oregon experience symptoms associated with depression and anxiety. The most common triggers for feeling stressed were a lack of time to spend with patients, demanding needs of patients, work schedules, physical and musculoskeletal pain, and difficulty maintaining a balance between work and personal life. The most common methods of stress management used were exercising, quiet time, and spending time with loved ones. While mental health symptoms were indicated by some of the respondents, few have sought services with a mental health care provider. Future research is needed on the mental health and well-being of dental hygienists on a national level to provide an understanding and a way to help manage symptoms of anxiety and depression to prevent burn-out.

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## References

1. National Institutes of Health. Mission statement [Internet]. Bethesda: National Institute of Health; 2018 [cited 2018 Nov15]. Available from: <https://www.nih.gov/about-nih/what-we-do/nih-almanac/national-institute-mental-health-nimh>.
2. National Institute of Mental Health. Major depression [Internet]. Bethesda: U.S. Department of Health and Human Services; 2019 [cited 2018 Nov13]. Available from: <https://www.nimh.nih.gov/health/statistics/major-depression.shtml>.
3. National Institute of Mental Health. Any anxiety disorder [Internet]. Bethesda: U.S. Department of Health and Human Services; 2018 [cited 2018Nov12]. Available from: <https://www.nimh.nih.gov/health/statistics/any-anxiety-disorder.shtml>
4. Gorter R. Work stress and burnout among dental hygienists. *Int J Dent Hyg.* 2005 May; 3(2):88–92.
5. Deckard GJ, Rountree B. Burnout in dental hygiene. *J Dent Hyg* 1984 July; 58: 307–13.
6. Lopresti S. Stress and the dental hygiene profession: risk factors, symptoms, and coping strategies. *C J Dent Hyg.* 2014; 48(2): 63-9.
7. Petrén V, Petzall K, Preber H, et al. The relationship between working conditions and sick leave in Swedish dental hygienists. *Int J Dent Hyg.* 2007; 5(1): 27–35.
8. Ylipaa V, Szuster F, Spencer J, et al. Health, mental well-being, and musculoskeletal disorders: a comparison between Swedish and Australian dental hygienists. *J Dent Hyg.* 2002; 76 (1): 47-58.
9. Rada RE, Johnson-Leong C. Stress, burnout, anxiety and depression among dentists. *J Am Dent Assoc.* 2004; 135(6):788–94.
10. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med.* 2012;172(18):1377-85.
11. Friedberg MW, Chen PG, Van Busum KR, et al. Factors affecting physician professional satisfaction and their implications for patient care, health systems and health

policy. *Rand Health Q.* 2014 Dec 1;3(4):1. eCollection Winter 2014.

12. McHugh MD, Kutney-Lee A, Cimiotti JP, et al. Nurses' widespread job dissatisfaction, burnout, and frustration with health benefits signal problems for patient care. *Health Aff (Millwood)*. 2011; 30(2):202-10.
13. Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs [Internet]. Chicago: American Dental Association; 2019 [cited 2019 Mar 12]. Available from: [http://www.ada.org/-/media/CODA/Files/2016\\_dh.ashx](http://www.ada.org/-/media/CODA/Files/2016_dh.ashx)
14. Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. *Annals Fam Med.* 2014; 12(6):573–6.
15. Hojat M, Louis DZ, Markham FW, et al. Physicians' empathy and clinical outcomes for diabetic patients. *Acad Med.* 2011; 86(3):359-64.
16. DiMatteo MR, Sherbourne CD, Hays RD, and et al. Physicians 'characteristics influence patients' adherence to medical treatment: results from the Medical Outcomes Study. *Health Psychol.* 1993; 12(2):93-102.
17. Williams ES, Skinner AC. Outcomes of physician job satisfaction: a narrative review, implications, and directions for future research. *Health Care Manage Rev.* 2003; 28(2):119-39.

## The Effect of Mobile Text Messages and a Novel Floss Holder on Gingival Health: A randomized control trial

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### Abstract

**Purpose:** The purpose of this study was to evaluate the effects of using mobile text messages and a novel floss holder as compared to finger flossing or the novel floss holder alone, on the psychological, behavioral, and clinical parameters of patients with gingivitis.

**Methods:** A total 165 adults were assessed for eligibility and 144 met the criteria for randomization into three groups: Finger Floss (FF, n=43), Novel Floss Holder (NFH, n= 40 ), and Novel Floss Holder plus Text Messages (NFH+TM, n= 61) following a dental hygiene consultation appointment. Gingival bleeding points were measured on probing (BOMP) at baseline and four months later by a calibrated dental hygienist, blinded to the experimental groups. Participants also self-reported their oral hygiene behaviors, and indicated psychological determinants of behavior change prior to the dental hygiene consultation and at four months. Descriptive statistics and repeated measures analysis of variance (ANOVA) were used to compare groups over time.

**Results:** Two subjects dropped out of the study making the total number of participants 142. At the four month follow-up, the NFH group and the NFH+TM groups demonstrated significantly higher levels of self-reported flossing, action self-efficacy, intention, action planning, and action control. The NFH+TM group showed lower levels of bleeding and higher levels of oral hygiene and recovery self-efficacy than the other groups, in addition to higher levels of maintenance self-efficacy as compared to the FF group.

**Conclusions:** The use of a novel floss holder, NFH, was shown to improve the behavioral and psychological determinants of periodontal health four months after introduction of the device. However the clinical measures of BOMP only improved significantly when used in conjunction with text messages (NFH+TM). The use of a consciousness awareness technique, TMs, in combination with a novel device, may help patients to reach therapeutic objectives and contribute to the management of periodontal pathologies such as gingivitis.

**Keywords:** flossing, interdental cleaning, gingivitis, patient motivation, oral self-care, oral hygiene, mobile text messages

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### Introduction

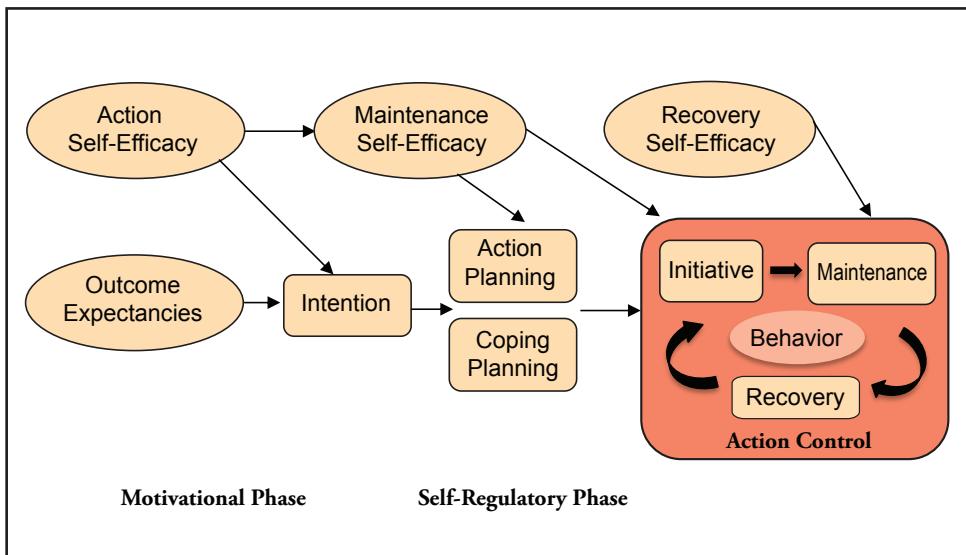
Mechanical control of biofilm is the primary therapeutic strategy for preventing gingival diseases.<sup>1,2</sup> Toothbrushing plays an important role to that end and is the most commonly used means of controlling plaque<sup>2</sup> but toothbrushing alone is not sufficient for efficiently reaching into interdental surfaces.<sup>3</sup> Recent literature reviews have identified interdental brushes (IDB) as the most effective interdental cleaning devices.<sup>3,4</sup> However, some limitations have been noted for IDB, as several shapes and sizes are required and most of the interdental spaces in the anterior teeth are too narrow for their use.<sup>3</sup> Additionally, other researchers have drawn attention to the scarcity of well-designed studies demonstrating the relative

clinical value of flossing, arguing that it may be premature to discontinue the use of floss.<sup>5</sup> A more recent systematic review mentions that both floss and interdental brushes may contribute to reducing gingivitis.<sup>4</sup> Many researchers are advocating for oral health care professionals to change their mindset from flossing to interdental cleaning. Selection of the best interdental cleaning device should be made according the dimensions of the embrasure space combined with patients' skill levels and motivation, not based exclusively on the comparative results of efficacy.<sup>3-5</sup>

Individuals often fail to exert control over their own behavior despite being motivated to do so,<sup>6</sup> and this self-

control can be even more challenging when routine behaviors are involved, such as those related to oral hygiene. Some models of health behavior change, such as the Health Action Process Approach (HAPA),<sup>7</sup> take volitional or self-regulatory aspects of behavior into consideration. According to the HAPA, a change in health behavior is the result of a motivational phase where individuals form an intention to act. However, it also involves volition, the cognitive process by which an individual decides on and commits to a particular course of action, as well as a post-intentional phase where the individual plans how to put their intentions into practice and maintain their behavioral changes.<sup>6-9</sup> When compared to other social cognitive models, the HAPA has been shown to be a good predictor of oral hygiene behaviors.<sup>8,9</sup> The HAPA is illustrated in Figure 1.

**Figure 1. The Health Action Process Approach (HAPA)<sup>7</sup>**



It is also known that individuals thrive on novelty and challenge, seeking new experiences and stimulating activities.<sup>10,11</sup> Under most theories of motivation, both curiosity and a personal sense of control influence readiness and motivation to initiate behavior and expend effort.<sup>12</sup> This is particularly important when approaching new situations, such as using a novel floss holder or receiving text messages about oral health issues. Floss holders have a long history of use, with studies showing benefits for patients lacking the dexterity to use finger flossing, and in helping patients establish a long-term flossing habit as compared to finger flossing.<sup>13,14</sup> New or novel floss holders (NFH) may be a way to increase curiosity, control, and flossing frequency, thereby fostering oral hygiene efficacy.

One method of disrupting undesired habits, such as failing to control plaque biofilm in interdental spaces, is by bringing habitual behavior and its context to conscious awareness.<sup>9</sup> Consciousness-raising for health behavior may be facilitated by mobile digital technologies, which provide the opportunity to display habit-disrupting cues.<sup>15</sup> Mobile text messages (TM) may offer an opportunity to disrupt an undesirable habitual behavior by keeping a goal salient or by bringing the goal back to working memory at an appropriate point in time. Moreover, according to a recent systematic review and meta-analysis,<sup>16</sup> the use of mobile health interventions has been shown to positively influence communication between patients and providers, facilitating patient-centered healthcare. In the same vein, TMs have also been shown to foster social support mechanisms.<sup>17</sup>

It is not known whether the use of a consciousness awareness technique such as a TM in combination with a novel device such as the NFH, could lead to a new behavior and ultimately improved oral health. The purpose of this randomized controlled trial was to investigate whether the effect of using a NFH would improve compliance and help to develop positive health behaviors to promote gingival health and to investigate the effect of TMs on increasing the sustainability and clinical efficacy of those behaviors between dental hygiene care appointments.

## Methods

### Sample selection

Interested participants were recruited among the local urban community, through newspaper ads and advertisements in local shops in Caldas da Rainha, Portugal. A total of 165 patients were initially assessed, however 21 patients failed to meet the inclusion criteria (age 18 years or older, having 20 teeth with a minimum of five teeth per quadrant, periodontal pockets >3mm and Bleeding on Marginal Probing >0.5, non-smoker, not pregnant, not in orthodontic treatment and not having removable partial dentures). A dental hygiene consultation appointment including professional mechanical plaque removal (scaling and polishing) and oral hygiene instruction was delivered to participants by an experienced dental hygienist in two private dental clinics; the clinical trial was conducted over a span of four months with two assessment points. Data confidentiality and anonymity were assured and the ethics committees of the University of Lisbon and the Escola Superior de Saúde de Portalegre approved the clinical trial (Ethics Committee Doc. No. 6/14). The study was registered at the ClinicalTrials.gov database (NCT03120559).

## Procedures

Participants meeting the inclusion criteria, with the exception of the periodontal status, completed an online informed consent and a questionnaire with items addressing psychological determinants and oral health behaviors. Two weeks later, the gingival condition, Bleeding on Marginal Probing, (BOMP)<sup>18</sup> was evaluated by the experienced dental hygienist. After the bleeding index values were collected, each qualified participant was allocated, via computer-generated random sequencing, into one of three groups: Finger Floss (FF), Novel Floss Holder (NFH), or Novel Floss Holder plus Text Messages (NFH+TM). Next, a dental hygiene consultation appointment was provided by the experienced dental hygienist who was blinded to the participant groups. The 60 minute dental hygiene appointments (professional scaling, polishing, and individualized oral hygiene instructions) were free of charge. Each session included behavior change techniques,<sup>20</sup> that were the same regardless of the participant's clinical trial group. Individualized oral hygiene instructions were delivered thorough verbal and practical demonstration (tell, show, and do) with the help of a hand mirror. The same BOMP assessments were performed and recorded four months later and the participants were asked to complete the post-questionnaire addressing psychological determinants and oral health behaviors. Items regarding TMs were added to the post-questionnaire. A flow chart of the study is illustrated in Figure 2.

A novel floss holder (GumChucks<sup>®</sup>; Oral Wise Inc.; Calabasas, CA, USA) was provided to the participants in the NFH and NFH+TM groups during the dental hygiene consultation appointment. The NFH resembles miniature nunchucks, featuring disposable tips connected by a piece of dental floss. The two-handle system is designed to increase dexterity and control, facilitating the recommended "C" shape with the floss. The FF group was provided a waxed, flavor free floss (GUM, ButlerWeave<sup>®</sup>; Sunstar Europe; Etoy, CH).

Subjects assigned to the NFH+TM group were informed about how the messaging system would operate and asked to provide their mobile phone number in order to receive the TMs, at the rate of one per week, over the next four months. Messages consisted of approximately 140 characters. Content related to oral hygiene and gingival inflammation and was designed to include characteristics described as important for improving efficacy and compliance, such as assertiveness, comprehensibility, originality, individualization and humor.<sup>19</sup> The TMs were pretested to an independent sample of 40 adults in order to evaluate their perceptions of the messages. A sample TM stated: *"It is impossible to sneeze with your eyes open, BUT it*

*is possible to take care of the gums between your teeth, even if it has been some time without doing so. You'll see! If you can, your gums will be healthy again. (Dental hygienist's name)"*

## Assessments

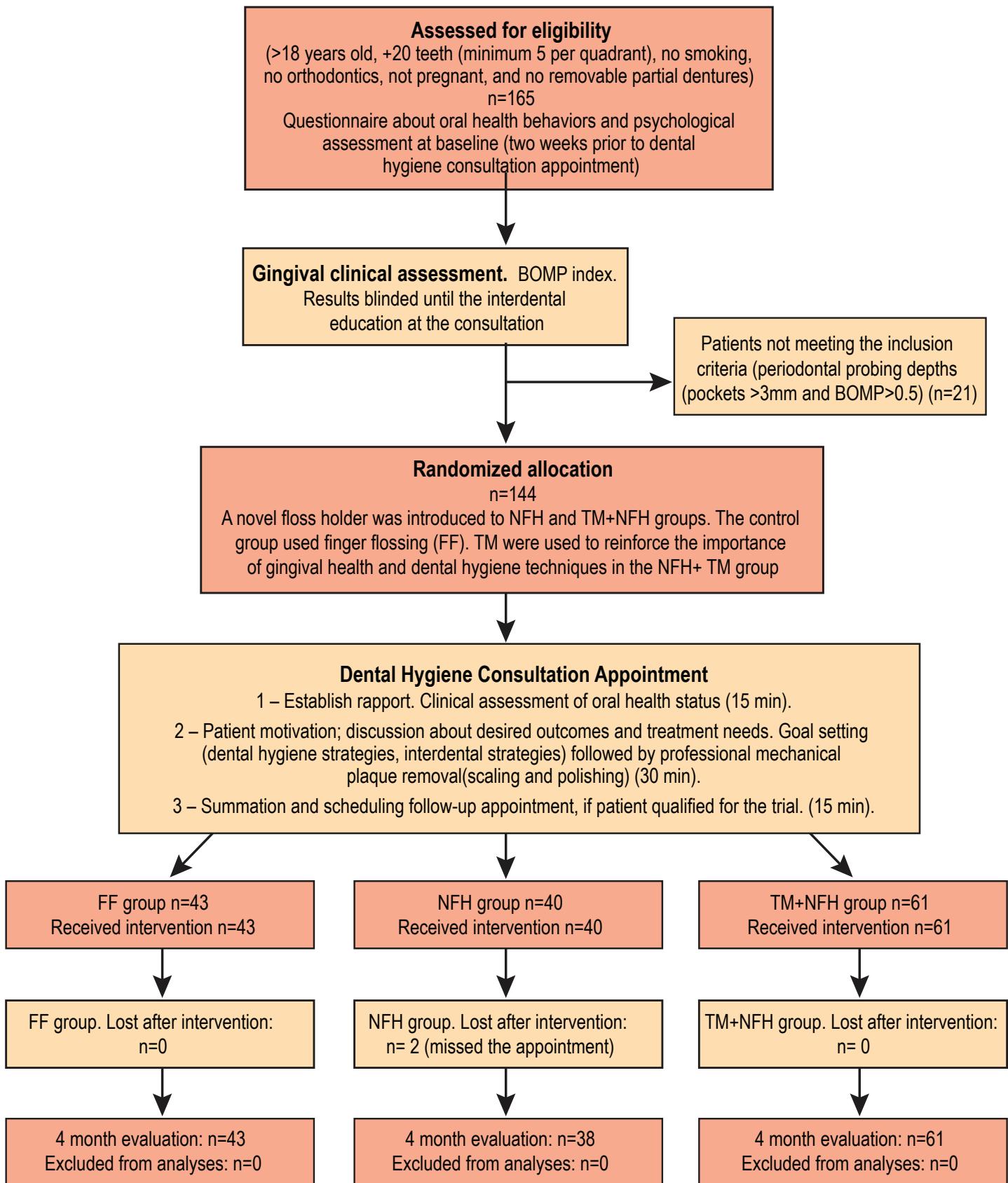
Gingival condition was assessed using the BOMP index, as described by Van der Weijden et al.<sup>18</sup> In this index, bleeding is scored during 30 seconds of probing using a 3-point scale, from 0 to 2 (0 = no bleeding, 1 = pinprick bleeding and 2 = excessive bleeding). Moderate gingivitis was defined as having at least 40% of the test sites showing bleeding on probing at the initial screening.<sup>18</sup> A healthy BOMP score was considered to be equal to or less than 0.5, or fewer than 25% of sites bleeding on marginal probing.<sup>21</sup> Four months after the initial appointment, the same procedure and measures were used. One-fifth of the patients were re-evaluated for BOMP by a second dental health professional blinded to the assigned groups, to determine inter-rater agreement at baseline and four months. High agreement was found between the two dental health professionals who evaluated the BOMP ( $\kappa=.718$ ; 95% CI, .50; .94,  $p < .001$ ).

Participants were asked two questions regarding brushing and flossing habits using a 5-point scale, 1) not using, 2) barely, 3) once a day, 4) twice a day, 5) more than twice a day, in order to evaluate their oral hygiene habits. Scores for brushing and flossing were calculated and a composite (mean) score for oral hygiene was also computed. Satisfaction with the NFH was assessed by: "How do you rate the use of the NFH? Response options included: "They are easy to use and I like them, I like them, but they are difficult to use, I don't like them, and They are a waste of time".

Measures were adapted for oral health behaviors from previous studies using the HAPA model<sup>22</sup> using a seven-point Likert-type scale ranging from 1) "totally disagree," to 7) "totally agree." Evaluation of the TM, according to the overall interest (comprehensibility, interest, and relevance) and usefulness, was measured by adapting a 10-item scale<sup>22</sup> with responses using a five-point Likert scale. A four-point scale ranging from 1) "Less than one message per week" to 4) "More than three messages per week" was also used to determine the frequency at which participants were willing to receive more messages. In order to inquire regarding how participants reacted to receiving the TM, a five-point scale was used, ranging from 1) "Ignored it" to 5) "Read it immediately."

To ensure that the effects on gingival health were not dependent on the dental hygiene consultation appointment, a four-item checklist (introduction and diagnosis, explanations,

**Figure 2. Flowchart of randomized control trial**



hygiene goals, and clinical procedures) was used. In order to verify whether the consultation script was similar for all the patients, the fidelity of the intervention was checked by two other oral health professionals for more than one-fifth of the randomly selected consultation appointments. In 80% of the checked appointments, 100% fidelity was obtained; the fidelity was above 90% for the remaining 20%.

### Data analysis

A dropout analysis and a randomization check was performed through multivariate analysis of variance (MANOVA) for the psychological determinants, behavior, and clinical gingival outcome; ANOVA and Chi-square tests were used to compare continuous and categorical variables, respectively. Distribution normality (Shapiro-Wilk) and variance homogeneity (Levene's test) were verified for all outcome variables. To compare the three groups at the four-month follow-up, mixed between/within-subject repeated measures ANOVA with each intervention group (FF, NFH, NFH+TM) times the assessment time (baseline vs. four months) were computed. Whenever differences of interest were found at baseline in outcome variables, the same analysis was repeated introducing baseline scores as a covariate.

## Results

### *Dropout analysis and randomization check*

No significant differences between the longitudinal sample ( $n=142$ ) and those who dropped out ( $n=2$ ) were found in any baseline sociodemographic variables. However, a difference was identified in intention, which was lower among those who dropped out ( $M=4.00$ ,  $SD=4.24$ ) as compared to those who remained in the study ( $M=6.00$ ,  $SD=.86$ ),  $p=.003$ . No differences across the three groups were found at baseline in relation to sociodemographics, frequency of flossing, tooth brushing, or BOMP, nor on most of the psychological determinants ( $p>.10$ ). Exceptions were found for intention, maintenance self-efficacy, and coping planning. At baseline, intention was significantly higher in the FF group than in the NFH+TM group; maintenance self-efficacy was significantly higher in the FF and NFH groups than the NFH+TM group; and coping planning was higher in the NFH+TM than the NFH group (all at  $p<.05$ ).

### *Descriptive statistics*

Descriptive demographic data for the sample are presented in Table I. Participants' daily frequency of flossing was low at baseline ( $M=1.7$ ,  $SD=.79$ ); the majority either never or barely used dental floss. Reference to other interdental devices for dental plaque control was low, with only 2.8% of individuals using interdental brushes. However, the majority of the sample

**Table I. Sample demographics (n = 142)**

Demographic characteristics	FF (n = 43)	n (%) NFH (n = 38)	NFH+TM (n = 61)
<b>Sex</b>			
Women	28 (65%)	21 (55%)	35 (57%)
Men	15 (35%)	17 (45%)	26 (43%)
<b>Age</b>			
18-24 years	12 (28%)	4 (10%)	7 (12%)
25-34 years	10 (23%)	9 (24%)	18 (30%)
35-44 years	8 (19%)	11 (29%)	24 (39%)
45-54 years	7 (17%)	8 (21%)	8 (13%)
55-75 years	5 (11%)	5 (13%)	4 (6%)
> 75 years	1 (2%)	1 (3%)	0 (0%)
<b>Highest level of education</b>			
Basic education	1 (12%)	3 (8%)	0 (0%)
Secondary education	3 (7%)	7 (18%)	3 (5%)
Higher secondary education	14 (33%)	15 (39%)	24 (39%)
University and post-graduate education	25 (48%)	13 (35%)	34 (56%)
<b>Occupation</b>			
Actively employed	36 (83%)	29 (77%)	50 (82%)
Unemployed	5 (12%)	7 (18%)	9 (15%)
Retired	2 (5%)	2 (5%)	2 (3%)

brushed their teeth twice a day. The initial level of BOMP for the entire sample was relatively high, with an average of 60% bleeding points. The majority of the NFH+TM sample considered the messages useful for the new behavior and rated the TM very positively overall in regards to comprehensibility, interest, and relevance. Regarding the use of the NFH, 69% liked it after four months of usage, although around a third of participants reported some difficulties in using it. Oral hygiene behaviors at baseline and 4-months are shown in Table II.

### *Intervention effects on clinical and behavioral outcomes*

Values for interaction between group and time, and for the main effects of group and time at baseline and at the four-month follow-up, are presented in Table III. Significant interactions between the intervention group and time were obtained for BOMP ( $F[1,139]=262.95$ ,  $p<.001$ ), flossing ( $F[1,139]=134.74$ ,  $p<.001$ ), and oral hygiene ( $F[1,139]=103.07$ ,

**Table II. Oral hygiene behaviors at baseline and 4-months (n =142) NFH**

		<b>Baseline n (%)</b>	<b>4 months n (%)</b>
<b>Flossing</b>			
	Daily use	27 (19%)	81 (56%)
	Never use	115 (81%)	61 (44%)
<b>Toothbrushing</b>			
	Daily use	135 (95%)	139 (98%)
	Never or barely use	7 (5%)	3 (2%)
<b>Other interdental device</b>			
	Daily use	4 (3%)	
	Never use	138 (97%)	
<b>Novel Floss Holder*</b>			
	I like the NFH and it's easy to use.		68 (69%)
	I like the NFH but it's not easy to use.		25 (25%)
	I don't like the NFH.		6 (6%)
<b>Text Messages**</b>			
	Overall positive opinion about TM.		55 (90%)
	Overall negative opinion about TM.		6 (10%)
	The mobile TM are useful.		54 (89%)
	The mobile TM are not useful.		7 (11%)
	I am willing to receive messages less than once per week.		17 (28%)
	I am willing to receive one message per week.		34 (57%)
	I am willing to receive more than one message per week.		10 (15%)
	When I received a message, I read it immediately.		36 (59%)
	When I received the message, I read it later that day.		12 (20%)
	When I received the message, I didn't read it that same day.		13 (21%)

\*NFH+TM groups (n =99); \*\*NFH+TM (n =61)

*p*<.001). While no differences between the groups were found for any of these three outcomes at baseline, the NFH+TM group presented a significantly lower BOMP values (i.e., 0.6; SD=.32) and a significantly higher level of oral hygiene than the other two groups at the four-month follow-up.

The average BOMP score in the NFH+TM group decreased from 1.2 (SD=.35) at baseline, to 0.6 (SD=.32) at 4 months, which corresponds to the decrease in bleeding sites at baseline from 60% to 30%, at 4 months. While the number of bleeding sites in the NFH+TM group was lower than the FF and

NFH groups, bleeding sites in the NFH group were not significantly lower than the FF group.

The NFH+TM group reported higher frequency of flossing at the four-month follow-up (67% of the individuals started using floss daily) as compared to the NFH group (50% started to use it daily), demonstrating a higher flossing frequency than the FF group (37% started to use it daily).

#### *Intervention effects on psychological determinants of oral hygiene*

Interaction effects between intervention group and assessment time were obtained for nearly all the assessed psychological determinants. The two exceptions were for outcome expectancies, which were not affected by either time or the intervention, and for coping planning, which was significantly affected by time alone. All groups demonstrated an increase in the planning of coping responses from baseline to four months, despite this increase only being significant in the NFH group ( $M_{diff}$  4month – baseline = 0.56,  $SE$  = 0.24,  $p$  = .02). While no significant differences existed between the groups at baseline in relation to action self-efficacy, action planning, or action control, the levels for these determinants at the four-month follow-up were significantly higher in both the NFH and NFH+TM groups as compared to the FF group.

Despite the FF group demonstrating a slight, but significantly higher, level of intention at baseline, the level of intention among participants in this group was significantly lower than those in the other two groups at the four-month follow-up. Participants in the NFH+TM group demonstrated a significantly higher level of intention than the NFH group. At the four-month follow-up, participants in the NFH+TM group showed significantly higher levels of maintenance self-efficacy as compared to FF, as well as demonstrating significantly higher levels of recovery self-efficacy than both FF and NFH groups. In summary, for the psychological determinants, the NFH+TM and the NFH groups showed a positive and significant change in action self-efficacy, action planning, and action control

**Table III. Item examples for behavioral, clinical, and psychological determinants (Cronbach's alpha, means\* and standard deviations)**

	Item example (Number of items in questionnaire)	Cronbach alpha			Baseline			4 months			Group comparison			
		Baseline (4-months)		FF n=43	NFH n=40	FF n=61	NFH n=38	FF n=61	NFH n=38	NFH+TM n=61	F	$\eta^2$	F	$\eta^2$
		FF n=43	NFH n=61	FF n=43	NFH n=38	FF n=61	NFH n=38	FF n=61	NFH n=38	NFH+TM n=61	Group	F	$\eta^2$	F
BOMP		1.15 (.32)	1.14 (.33)	1.19 (.35)	.82 (.26) <sup>a</sup>	.81 (.33) <sup>a</sup>	.62 (.33) <sup>b</sup>	1.43	.02	262.95**	.65	11.74***	.15	
Flossing	In the last two weeks/four months how often have you flossed your teeth? (1)	1.58 (.70)	1.84 (.86)	1.69 (.81)	2.28 (.63) <sup>a</sup>	2.53 (.51) <sup>b</sup>	2.80 (.54) <sup>c</sup>	4.50*	.06	134.74**	.49	4.45*	.06	
Toothbrushing	In the last two weeks/four months how often have you brushed your teeth? (1)	3.84 (.75)	3.82 (.77)	3.80 (.75)	3.91 (.75)	3.79 (.62) <sup>a</sup>	4.07 (.63) <sup>b</sup>	.50	.01	3.68	.03	2.70	.04	
Oral Hygiene (Brush and floss)		2.71 (.48)	2.83 (.58)	2.75 (.59)	3.09 (.48) <sup>a</sup>	3.16 (.45) <sup>a</sup>	3.43 (.37) <sup>b</sup>	2.61	.04	103.07**	.43	6.69**	.09	
Outcome Expectancies	Avoiding bleeding gums/ Avoiding bad breath (7)	.86 (.82)	5.68 (1.23)	5.79 (.79)	5.72 (.99)	5.75 (.79)	5.79 (.59)	.18	.00	1.12	.01	.51	.01	
Action Self Efficacy	I believe I can clean interproximally and brush daily, even if I need to change routines. (3)	.86 (.87)	5.64 (1.21)	5.81 (1.00)	5.67 (.82)	5.25 (.90) <sup>a</sup>	5.87 (.87) <sup>b</sup>	.90	.04	2.72	.04	.12	.00	
Intention	In the upcoming weeks I intend to carry out interproximal cleaning and brush my teeth daily. (3)	.89 (.87)	6.26 (.66) <sup>a,b</sup>	5.90 (1.20) <sup>b,c</sup>	5.91 (.71) <sup>c</sup>	5.30 (.74) <sup>a</sup>	5.92 (.88) <sup>b</sup>	.81	.05	3.28*	.05	4.83*	.03	
Maintenance Self Efficacy	I believe I can maintain my daily interproximal control and toothbrushing habits even if my relatives or roommate do not do so. (4)	.83 (.86)	5.41 (1.27) <sup>a</sup>	5.84 (1.13) <sup>a</sup>	5.31 (1.11) <sup>b</sup>	5.19 (.97) <sup>a</sup>	5.61 (.123) <sup>a,b</sup>	.05	.03	1.80	.03	.33	.00	
Recovery Self Efficacy	If I didn't control interproximal areas or brush my teeth on a daily basis, I believe I could start all over again. (3)	.81 (.78)	6.05 (1.12)	5.89 (1.21)	5.87 (.87)	5.47 (.82) <sup>a</sup>	6.36 (.81) <sup>c</sup>	.05	.03	3.28*	.05	4.83*	.03	
Action Planning	I already have plans for when I should brush my teeth on a daily basis, I believe I could start all over again. (3)	.81 (.72)	5.14 (1.40)	5.18 (1.51)	5.49 (1.20)	5.17 (1.15) <sup>a</sup>	5.96 (.97) <sup>b</sup>	.62	.02	2.02	.03	3.96*	.03	
Coping Planning	I have plans for what I should do if I have difficulties in practicing my dental hygiene. (3)	.78 (.80)	5.03 (1.34) <sup>a,b</sup>	4.71 (1.55) <sup>a</sup>	5.30 (1.29) <sup>b</sup>	5.10 (1.28)	5.27 (1.33)	.51	.04	2.15	.03	5.10*	.04	
Action Control	I evaluate my behavior to see if I'm brushing my teeth twice a day and cleaning between teeth daily. (3)	.78 (.80)	5.50 (1.05)	5.32 (1.31)	5.61 (.86)	5.05 (1.02) <sup>a</sup>	5.68 (.93) <sup>b</sup>	.93	.05	.62	.00	8.03**	.10	

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

\*Means with subscripts a,b,c represent significant differences in the pairwise comparisons.

as compared to the FF group. Intention and recovery self-efficacy increased in the NFH+TM as compared to the FF and NFH groups. Maintenance self-efficacy was higher in the NFH+TM group as compared to the FF group.

## Discussion

This study was designed to evaluate the effects of using a NFH combined with TMs between appointments, with the goal of improving gingival health. Changes in adherence to interdental hygiene cleaning behaviors, clinical outcomes, and underlying psychological determinants among patients with gingivitis were assessed. Participants who received TMs in addition to the NFH demonstrated higher frequencies of flossing four months following their initial appointment. Participants in the NFH+TM group, on average, attained the recommended daily frequency of dental floss use and consequently had lower levels of gingival bleeding than participants who used FF or the NFH exclusively.

The average BOMP score in the NFH+TM group decreased significantly from a baseline of 60% to 30% at the four-month follow-up and approached less than 25% of bleeding on probing sites, which has been considered to correspond to gingival health established by Barendregt et al.<sup>21</sup> However, it should also be acknowledged that the values for percentage of bleeding sites has been updated by Chapple et al, who defined periodontal stability as corresponding to fewer than 10% of bleeding on probing sites.<sup>23</sup> The use of floss by way of a NFH was more frequent at four months than in the FF group, although this difference in behavior was not translated into a significant difference in BOMP scores.<sup>4</sup> It was hypothesized that the NFH without TMs would also present a significantly lower BOMP scores than the FF group, however the results did not demonstrate any differences and supports findings from other studies where the efficacy of floss holders was no more effective than finger flossing.<sup>13,14</sup>

The use of TMs as reminders or “cues to action,” increasing proximity with the patient and frequency of flossing, was considered as a means of contributing toward effective use. In this regard, significant results were obtained for frequency of use. The combined use of TMs with the NFH contributed to a higher frequency of use in the NFH+TM group. These results were higher than those found previously in systematic reviews demonstrating that dental floss has a weaker effect on plaque or bleeding indices when used alone,<sup>3</sup> due to patients’ difficulty in accepting and using it correctly, as well as low levels of motivation and of dexterity.<sup>2,3,4</sup> Reported levels of satisfaction with the use of floss holders found in earlier studies, were also lower than the level of satisfaction with the NFH

identified in this study.<sup>13,14</sup> This higher level of satisfaction could have contributed to the increased motivation at follow-up, inferred by increases in action self-efficacy and intention, thus supporting the hypothesis that the NFH would increase motivation to use dental floss, due to its novelty and ease of use.

Levels of recovery self-efficacy were higher in the NFH+TM group, but the other self-regulation variables were shown to be as high as in the NFH group. One explanation for this may be that, as the messages functioned as reminders for oral hygiene behaviors, they reinforced the subjects’ beliefs that it is possible to return to and reach the objective, even following a lapse in the behavior (i.e., recovery self-efficacy). However, the NFH+TM group showed improved results at the behavioral level, without any significant differences in self-regulation variables (except in recovery self-efficacy), and may indicate that part of the TM effect on behavior operated via non-deliberated, automatic processes and was not mediated by deliberate self-regulatory cognitive processes.<sup>24</sup>

Results from this study showed an increase in motivation resulting from the use of a novel device to facilitate flossing, however only when accompanied by the use of TMs does the use of the NFH ultimately help reduce levels of gingival bleeding. Similarly to results previously described in the literature,<sup>25</sup> findings from this study showed that the use of floss improved with increasing levels of intention. However, intention alone did not attain the desired outcome, and other self-regulatory processes or cues to action must also be deployed. The TMs seem to have worked as a cue to action in the NFH+TM group, contributing to an effect on flossing that could not be fully explained through an increase in self-regulation. It was not the changes in planning, but rather changes in self-efficacy that helped to explain the behavioral (flossing frequency) and clinical modifications (improved gingival health) obtained.

Study participants had positive reactions to the TMs. Considering the formality that traditionally characterizes the relationship between the oral health professional and the patient,<sup>20</sup> the use of friendly and collaborative TMs may have contributed to forming closer relationships, facilitating patient-centered healthcare.<sup>16</sup> The TMs may also have contributed to behavior changes as they consisted of persuasive messages from a credible source and were also a source of social support, fostering patients’ self-efficacy and belief in being able to handle the challenge.<sup>16,20</sup>

Several limitations should be considered in the interpretation of the study findings. Although all participants used floss less often than the daily frequency recommended,

participants were generally motivated towards oral hygiene behaviors, as inferred by high levels of intention at baseline. This is not surprising, considering that all participants had gingivitis and had been invited to have it treated at no cost. Therefore the results can only be generalized to similarly motivated individuals with low levels of floss usage. In order to better understand the motivational contribution of a NFH, a group combining the use of FF with TMs will be important to include in future studies. Future studies should also consider the comparison of floss holder devices vs another type of interdental cleaning aid such as interdental brushes, water flossers, and wood sticks. In spite of its limitations, this study had several strengths. The study included the objective BOMP clinical measures as well as self-reported measures. Second, the dental hygiene consultation appointment was designed to include important behavior change techniques for all groups, representing an important addition to the routine care included in these appointments. Third, was the inclusion of a follow-up at four months, a shorter interval than normally used.<sup>4,20</sup> Future studies should look at the maintenance of these behaviors and gingival health status over longer periods of time.

Findings from this study have additional implications for practice, especially considering that TMs are inexpensive, easy to compose and apply. Text-messaging may be easily introduced into the routines of oral health professionals and integrated within a broader stepped, patient care approach.<sup>16</sup> The option of articulating different interventions (NFH+TM) is also innovative, seeking to create a multiaction strategy to optimize the oral health behaviors addressed in the dental hygiene appointment. Simply telling patients to brush and floss as part of their dental hygiene care appointment is just not working for many people.<sup>26</sup> However, flossing can be effective, if people become motivated to do it correctly and regularly.<sup>4,5</sup> Moving beyond motivation, demonstrating positive results in the self-regulation processes underlying behavioral change, is a useful finding. Even when interventions are effective in fostering motivation for change, translating intention into self-regulation for behavior change, is more difficult to achieve.<sup>22,27</sup>

## Conclusion

The use of a novel floss holder, NFH, was shown to improve behavioral and psychological determinants of periodontal health four months after introduction of the device. However, clinical parameters measured by reduction in bleeding points on probing, only improved significantly when the NFH was used in conjunction with text messages delivered via a mobile device. Mobile text messages can support patients' motivation and serve as an alternative pathway to create cues

to action, forming alternative routines and strategies. The use of a consciousness awareness technique, in combination with a novel device, such as a NFH, may help patients to reach therapeutic objectives and contribute to the management of periodontal pathologies such as gingivitis.

## Disclosure

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## References

1. Tonetti MS, Eickholz P, Loos BG, et al. Principles in prevention of periodontal diseases: consensus report of group one of the 11th European workshop on periodontology on effective prevention of periodontal and peri-implant diseases. *J Clin Periodontol.* 2015 Apr;42 (Suppl. 16):S5–S11.
2. Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis-a meta review. *J Clin Periodontol.* 2015 Apr;42 (Suppl. 16):S77–S91.
3. Sälzer S, Slot D, Weijden FV, et al. Efficacy of interdental mechanical plaque control in managing gingivitis—a meta-review. *J Clin Periodontol.* 2015 Apr;42;(Suppl.16):S92-S105.
4. Worthington HV, MacDonald L, Poklepovic Pericic T, et al. Home use of interdental cleaning devices, in addition to toothbrushing, for preventing and controlling periodontal diseases and dental caries. *Cochrane Database Syst Rev.* 2019 Apr; 10;(4):CD012018.
5. Vernon LT, Da Silva APB, Seacat JD. In defense of flossing: part II-can we agree it's premature to claim flossing is ineffective to help prevent periodontal diseases? *J Evid Based Dent Pract.* 2017 Sep;17(3):149-58.

6. Sniehotta FF, Scholz U, Schwarzer R, Bridging the intention-behavior gap: planning, self-efficacy and action control in the adoption and maintenance of physical exercise. *Psychol Healt*. 2005 Apr;20(2):143-60.
7. Schwarzer R, Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Appl Psychol-Int Rev*. 2008 Feb;57(1):1-29.
8. Scheerman J, Loveren C, Meijel B, et al. Psychosocial correlates of oral hygiene behaviour in people aged 9 to 19: a systematic review with meta-analysis. *Community Dent Oral Epidemiol*. 2016 Aug;44(4):331-41.
9. Dumitrescu AL, Dogaru BC, Duta C, Manolescu BN. Testing five social-cognitive models to explain predictors of personal oral health behaviours and intention to improve them. *Oral Health Prev Dent*. 2014 Mar;12(4):345-55.
10. Kashdan TB, Silvia PJ. Curiosity and interest: the benefits of thriving on novelty and challenge. In: Snyder CR, Lopez SJ, editors. *Oxford handbook of positive psychology*. 2<sup>ed</sup>. New York; Oxford University Press; 2009. p. 367-74.
11. González-Cutre D, Sicilia A, Sierra Rodriguez, et al. Understanding the need for novelty from the perspective of self-determination theory. *Pers. Individ. Differ*. 2016 Jul;102:159-69.
12. Bandura A. Self-efficacy: towards a unifying theory of behavioral change. *Psychol Rev* 1977 Mar;84(2):191-215.
13. Kleber CJ, Putt MS. Formation of flossing habit using a floss-holding device. *J Dent Hyg*. 1990 Mar;64(3):140-3.
14. Blanck M, Mankodi S, Wesley P, et al. Evaluation of the plaque removal efficacy of two commercially available dental floss devices. *J Clin Dent*. 2007 Feb;18(1):1-6.
15. Alkiş N, D Findik-Coşkunçay D. Use of persuasion strategies. In Sezgin E, Yıldırım SO, Sumuer E, editors. *Mobile health applications in current and emerging mHealth technologies. Adoption, implementation, and use*. Springer International Publishing; 2018. p.9-21.
16. Tonazzzo MP, Nodari D, Muniz FWMG, Weidlich P. Effect of mHealth in improving oral hygiene: a systematic review with meta-analysis. *J Clin Periodontol*. 2019 Mar;46(3):297-309.
17. Perri-Moore S, Kapsandoy S, Doyon K, et al. Automated alerts and reminders targeting patients: a review of the literature. *Patient Educ Couns*. 2016 Jun;99(6):953-9.
18. Weijden GA, Timmerman MF, Nijboer A, et al. Comparison of different approaches to assess bleeding on probing as indicators of gingivitis. *J Clin Periodontol*. 1994 Oct;21(9):589-94.
19. Gold J, Lim MS, Hellard ME, et al. What's in a message? Delivering sexual health promotion to young people in Australia via text messaging. *BMC Public Health*. 2010 Dec;10(1):792.
20. Newton TJ, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. *J Clin Periodontol*. 2015 Apr;42(Suppl 16): S36-46.
21. Barendregt DS, Timmerman MF, Velden U, Weijden G. Comparison of the bleeding on marginal probing index and the Eastman interdental bleeding index as indicators of gingivitis. *J Clin Periodontol*. 2002 Mar;29:195-200.
22. Araújo MR, Alvarez MJ, Godinho CA, Roberto MS. An eight-month randomized controlled trial on the use of intra-oral cameras and text messages for gingivitis control among adults. *Int J Dent Hyg*. 2019 Aug;17(3):202-13.
23. Chapple I, Dommisch H, Glogauer M, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: consensus report of workgroup one of the 2017 World Workshop on the classification of periodontal and peri- implant diseases and conditions. *J Periodontol*. 2018 Jun;89(Suppl 1) S74-S84.
24. Hofmann W, Friese M, Wiers RW. Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review. *Health Psychol. Rev*. 2008 Dec; 2(2):111-37.
25. Zhou G, Sun C, Knoll N, etc. Self-efficacy, planning and action control in an oral self-care intervention. *Health Educ Res*. 2015 Aug;30(4):671-81.
26. Wilder RS. Telling them to brush and floss is just not working. *J Dent Hyg*. 2013 Dec;87(6):318.
27. Solberg LI, Brekke ML, Fazio CJ, et al. Lessons from experienced guideline implementers: attend to many factors and use multiple strategies. *J Qual Patient Saf*. 2000 Apr;26(4):171-88.

## Postmortem Dental Records Identification by Dental Hygiene Students: A pilot study

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### Abstract

**Purpose:** Dental hygienists have the potential for filling critical roles in multidisciplinary victim identification teams. The purpose of this pilot study was to evaluate the accuracy of dental hygiene students utilizing dental charting, bitewings, and skull dentitions for the purpose of making identification matches.

**Methods:** Thirty senior dental hygiene students ( $n=30$ ) independently viewed an asynchronous online multimedia-based presentation on the procedures used for collecting and recording forensic dental evidence. Following the presentation participants attempted to chart and match three bitewing radiograph sets to three human skull dentitions by correlating matches/exclusions. Immediately following the activity, each student completed a questionnaire rating the difficulty of the exercise, as well as their confidence, and willingness to volunteer as a forensics team member. Descriptive statistics were used to analyze the data.

**Results:** Of the total sample 36.7% ( $n=11$ ) reported having prior experiences with dental radiography; while the majority (63.33%,  $n=19$ ) reported no prior experience. Participants' accuracy scores for dental charting ranged from 91.23% ( $SD=9.42$ ) to 99.06% ( $SD=3.60$ ), with no statistically significant difference based on prior experience ( $p>0.05$ ). The average interrater reliability was 86% ( $p<0.0001$ ), indicating a high level of agreement with charting skulls and radiographs. No statistically significant differences were found for charting time, perceived difficulty, or level of confidence when comparing experience among the participants ( $p>0.05$ ).

**Conclusions:** Regardless of previous experience, dental hygiene students were able to match postmortem dentitions and radiographs with good interrater reliability and did not differ statistically for charting time, perceived difficulty, or confidence. Results suggest dental hygienists can work as effective victim identification team members when educational programs are implemented.

**Keywords:** dental hygienists, dental hygiene students, dental radiology, radiographic interpretation, forensic odontology, forensic education

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### Introduction

Historically, the scientific process of collecting and comparing dental evidence for the purposes of identifying human remains has been utilized with great success.<sup>1,2</sup> Comparing antemortem (AM) and postmortem (PM) unique concordant features of the human dentition and surrounding structures is a reliable biometric tool for establishing the legal identification of human remains.<sup>2-4</sup> Human teeth maintain integrity during exposure to extreme temperatures and during the process of human decomposition.<sup>5,6</sup> Dental charting and

comparisons of AM and PM dental radiographic evidence are of central importance, especially in cases of physical damage rendering the body incapable of producing fingerprints or any other form of biometric identification.<sup>2,7,8</sup>

During previous occurrences of mass fatalities, comparison teams, including volunteer dental and non-dental members, have been utilized to assist in victim identification when the availability of forensic odontologists was limited.<sup>9-16</sup>

Concerns have been raised regarding the use of disaster victim identification (DVI) team members who are not forensic odontologists, due to lack of standardization in volunteers' formal education, experience, and cognitive bias.<sup>4,7,16-18</sup> Wenzel et al. and Zohn et al. suggest that prior to DVI participation, volunteers should demonstrate competence in simulated scenarios.<sup>16,17</sup> Several studies have tested the competence of participants with various education and experience to see if there are differences in how they perform with DVI tasks. Participants with formal dental-related education have been shown to outperform participants who have no dental-related education.<sup>4,7,17</sup> Having prior dental-related education could be beneficial, especially during mass fatality incidents (MFI) when there is a shortage of forensic odontologists and comparison team members.<sup>4,7,17</sup> Pinchi et al. conducted a study comparing the abilities of participants with no dental education (emergency room specialists, legal medicine specialists) to participants with dental education (dental students, dentists, dentists with forensic education, and forensic odontologists), and found participants with dental education had correct answer rates of 85% to 96% and significantly outperformed participants with no dental education with a correct answer rate of 67%.<sup>7</sup> Pinchi et al. also found that the accuracy of dental students was similar to dentists who had forensic education; however, forensic odontologists outperformed all participants, especially in very difficult cases.<sup>7</sup> The inter-operator variability for the forensic odontologists was also lower when compared to other groups in the study, pointing to reliable consistency in expert opinion among forensic odontologists.<sup>7</sup>

Dental hygienists can fill critical roles as members of multidisciplinary victim identification and records reconciliation teams.<sup>9-13,15</sup> The literature has shown that dental hygienists have been beneficial members of AM, PM, and comparison teams, and have the ability to aid in the management of administrative and miscellaneous duties as they relate to DVI during MFIs.<sup>15</sup> Additionally, a 2014 survey of dental hygienists in the United States (n=334) found that 85.6% were interested in DVI as a community service opportunity and of those showing interest, 91.6% indicated intentions for becoming involved.<sup>15</sup> Dental hygienists have relevant educational coursework closely interrelated with the curriculum covered in forensic odontology, including anatomy, radiology, embryology, oral pathology, and biomaterials.<sup>4,19,20</sup> However, little has been reported in the literature evaluating the effectiveness and reliability of the curriculum, assessments, or in-time trainings for dental hygienists with an interest in forensic-based practice.<sup>13,14,16</sup> A review of the literature revealed that curriculum guidelines and best practices for

assessment of skills and competencies related to DVI are not well established and lack standardization.<sup>2,7,8,17,18</sup> In a study by Sholl et al., forensic odontologists, dental students, and dental hygiene students compared dental radiographs taken from dry skulls to test accuracy of matching influenced by rater experience.<sup>4</sup> Dental hygiene students performed better than the dental students, 89.7% versus 85.2% accuracy, however, forensic odontologists performed best with 93.3% accuracy.<sup>4</sup> While the authors suggested that dental hygiene students may have performed better than the dental students due to more recent coursework in anatomy and a more acute awareness of tooth morphology, they also concluded that a DVI team with allied dental professionals who have successfully completed discipline related coursework, could benefit DVI.<sup>4</sup>

Research by Sholl et al. also identified that forensic odontologists with DVI experience performed better than odontologists with only formal education, suggesting that competence for accurate matches may increase with experience.<sup>4</sup> This observation was also noted by Pinchi et al. who stated that actual experience in forensic odontology was a better indicator of identification performance when compared to formal education in forensic odontology alone.<sup>7</sup> A study of non-forensically trained dental students (n=152) by Sivaneri et al. found that 92.1% of the first, second, and third year students were able to correctly match PM radiographs of heat altered teeth to AM radiographs, and that there were no statistically significant differences in the students' abilities to make matches based on their standing in the program.<sup>19</sup> These researchers hypothesized that knowledge and skills gained from formal coursework in dental anatomy and radiology could transfer to dental forensic skills, despite an absence of dental forensics in the curricula.<sup>19</sup>

When evaluating the amount of time for raters to make forensic matches, two studies found that dental students spent less time completing identification tasks as compared to experienced forensic odontologists, while non-dental professionals took considerably more time when completing identification tasks.<sup>7,16</sup> Pinchi et al suggested that a lack of experience with dental radiographic interpretation could explain the increased time taken by non-dental specialists.<sup>7</sup> It has also been hypothesized that the increased time required by experienced forensic odontologists may be the result of a more thorough examination conducted with caution, versus haste, in assignment of matches.<sup>7,18</sup>

It has been suggested that the forensic odontology curriculum for dental volunteers should include simulated disaster events with hands-on activities, and exercises allowing learners the opportunity to attempt identification

matches.<sup>17</sup> In a study by Wenzel et al., dental students, forensic odontologists, and a radiologist tested pattern recognition of anatomical morphology in unrestored teeth using film AM radiographs and digital PM images from dry skulls.<sup>16</sup> In this study, the number of incorrect scores between the experts and the students was found to be low and not statistically significant ( $p<0.02$ ). Dental students were found to spend less time deciding on matches, but needed more PM images to decide on matches as compared to the experts.<sup>16</sup> Wenzel et al. found that the ability of the participants to make matches increased with periapical images as compared to bitewings,<sup>16</sup> which conflicts with the findings of Sholl et al.<sup>4</sup> However, in a retrospective study of a closed roster airplane crash by Bux et al., while the absence of AM radiographs did not impede identification efforts, the importance of AM radiographs for open disasters with many victims was also cited.<sup>21</sup> According to the American Board of Forensic Odontology (ABFO) 2017 Diplomates Reference Manual, PM radiographs are required for most victim identifications and should be relied on as a primary tool, especially when AM radiographs are not available.<sup>22</sup> Currently, there is no standard protocol for comparing radiographs when deciding on matches.<sup>3,7,18</sup>

The lack of standardization among DVI volunteers can make it difficult to determine whether volunteers are competent.<sup>17</sup> Dental volunteers involved in DVI activities must be competent in their ability to critically evaluate dental evidence and accurately make conclusions regarding identification matches in a manner consistent with acceptable medico-legal standards.<sup>3,18,19</sup> The purpose of this pilot study was to evaluate the accuracy of dental hygiene students in the utilization of dental charting bitewings and skull dentitions for the purpose of making identification matches.

## Methods

A convenience sample of senior dental hygiene students ( $n=30$ ) from Old Dominion University (ODU) were invited by email and verbal announcement to participate in this ODU Institutional Review Board exempt (#1322640-3) study. All participants had successfully completed the same formal coursework of head and neck anatomy, histology, embryology, periodontology, dental radiology, and dental materials; and completed the informed consent letter. Participants then logged into the learning management system (Blackboard, Inc<sup>®</sup>; Providence Equity Partners, Washington, D.C.) to view a researcher-designed, online multimedia PowerPoint presentation explaining the concepts and procedures for collecting and recording forensic dental evidence and comparisons of the evidence for the purpose of making identification matches. Students viewed the asynchronous

presentation independently at their convenience through the learning management system. Time lapses between viewing the presentation and participating in the research project were not tracked. Participants then were asked to chart and match three bitewing radiograph sets to three human skull dentitions by correlating matches/exclusions. At the completion of the charting and matching activity, the participants completed a researcher designed questionnaire rating the difficulty of the exercise, as well as their confidence, and willingness to volunteer as a forensics team member.

### ***Identification procedure***

The principal investigator (PI) exposed a set of four horizontal bitewing digital radiographic images on three dry human skulls; the skulls were then mounted to reclined dental chairs. The radiographic image sets were enlarged, printed, and placed on podium stands next to the mounted skulls (Figure 1). The bitewings were randomly labeled 1, 2, 3 and the corresponding skulls were randomly labeled A, B, C. The participants were informed that the bitewings had been mismatched from the skulls. Each participant was provided with six paper dental charting forms (one for each set of radiographs and one for each of the three skulls). The forms were in the same order as the randomized bitewings and skulls, and each participant proceeded in the same order in the room where the study took place.

**Figure 1. Bitewing radiographic set randomly mismatched with a skull**



Each participant identified the imaged teeth for the three sets of PM dental radiographs and identified the dentition of the three skulls in the following order: skull C, bitewing set #1, skull A, bitewing set #2, skull B, bitewing set #3. Participants were asked to identify each tooth in the image as: present, missing, or as having a dental restoration. They were then asked to do the same for each tooth in the three human skulls. Finally, the participants were asked to match each bitewing radiographic set with its corresponding skull based on the dental evidence recorded on the six dental charting forms. Participants were not

asked to qualify their answers for matches based on categories and terminology for identification as required by the ABFO (e.g. positive identification, possible identification, insufficient evidence, exclusion).

Each participant was timed while completing the dental charting and deciding on identification matches however this was unknown to the participant. Entry to the study operatory was limited to one participant at a time and participants were allowed to revisit the bitewing sets and skulls to check their answers during the session. At the conclusion of the identification exercise, participants completed a researcher-designed, paper questionnaire consisting of twelve items regarding the difficulty of the tasks, their level of confidence, and their feelings about volunteering as a forensics comparison team member in the future. Participants indicated whether they had previous work experience with exposing and interpreting dental radiographs. A follow-up question for positive responders inquired whether they felt that their formal dental hygiene coursework helped to improve their skills with exposing and interpreting radiographs, recognizing dental restorations, and recognizing anatomical differences in teeth and bone. Prior experience, or the lack thereof, was utilized to conduct the interrater reliability comparison, and to investigate whether prior experience influenced accuracy, charting time, perceived difficulty, and confidence while making identification matches.

The study's methodology was supported by the experimental design by Sholl et al., which included forensic odontologists, dental students, and dental hygiene students who attempted to make matches with AM and PM bitewings and periapicals from dry skulls and also suggested that the type of radiograph did not affect the accuracy when used as a matching tool.<sup>4</sup> The research design also took into consideration the amount of time participants would devote to the identification exercise between classes and other obligations. Therefore, the exercise limited the number of radiographs and skulls to three each, to avoid overwhelming the participants with an activity that would be too time consuming. The amount of time required for subjects to complete research activities has been considered in other studies along with a consideration of not causing mental fatigue for participants.

#### **Statistical analysis**

The participants' demographic information, their accuracy grades for dental charting, as well as their levels of perceived difficulty and confidence were summarized and compared between level of experience using the Chi-square test or the Fisher's Exact test for categorical variables, and the Student's *t* test for continuous variables. Level of experience was a binary

variable, representing whether a participant had experience with exposing and interpreting dental radiographs prior to entering dental hygiene school. Categorical data were presented as frequencies and proportions, whereas continuous data were presented as means and standard deviations. The %MAGREE macro for multiple raters with multi-categorical ratings, was used to compute the Kappa statistics to test charting agreement among all participants.<sup>23</sup> All statistical analyses were performed using SAS 9.4 (SAS Institute, Inc., Cary, NC), and statistical significance was determined using an alpha level of 0.05.

## **Results**

A convenience sample of senior dental hygiene students agreed to participate and completed the simulated dental charting and identification matching activity and post-questionnaire. All participants were female (n=30) and a little more than one-third (36.67%, n=11), reported having at least one year of work experience with exposing and interpreting dental radiographs prior to entering the dental hygiene program. Participant demographic data is shown in Table I.

**Table I. Sample demographic characteristics (n=30)**

Demographics	n	%
<b>Gender</b>		
Female	30	100%
Male	0	0%
<b>Age Range</b>		
18-22	11	36.67%
23-27	12	40%
28-32	6	20%
38-42	1	3.33%
<b>Experience with exposing and interpreting dental radiographs prior to dental hygiene school</b>		
≥1 year prior experience	11	36.67%
No prior experience	19	63.33%

The participants' mean accuracy scores for the dental charting of bitewing radiographs ranged from 91.23% (SD 9.42) to 95.49% (SD 7.20), and ranged from 93.94% (SD 7.70) to 99.06% for charting the skull dentitions. No statistically significant difference was found between experienced and non-experienced participants in terms of accuracy for dental charting the bitewing radiographs or skull dentitions (all  $p>0.05$ ). Additionally, all participants successfully matched the radiographic sets and corresponding skulls with 100% accuracy. The participants' dental charting accuracy is shown in Table II.

**Table II. Mean accuracy for dental charting of skulls and bitewing radiographs**

Dental Charting Accuracy	Overall sample n=30	Prior experience n=11	No experience n=19	p value
Skull A, Mean (SD)	98.21 (2.70)	98.56 (2.94)	98.00 (2.62)	0.5912
Skull B, Mean (SD)	99.06 (3.60)	100.0 (0.00)	98.51 (4.48)	0.2830
Skull C, Mean (SD)	93.94 (7.70)	93.75 (8.39)	94.05 (7.52)	0.9197
BWX* 1, Mean (SD)	95.49 (7.20)	96.85 (3.96)	94.71 (8.55)	0.4435
BWX* 2, Mean (SD)	91.23 (9.42)	93.16 (7.26)	90.11 (10.49)	0.4018
BWX* 3, Mean (SD)	92.68 (5.82)	92.86 (5.43)	92.57 (6.19)	0.8982

\*Bitewing radiographs

Kappa statistics for assessing dental charting reliability agreement between participants ranged from 0.81 to 0.89 for the three sets of radiographs, and from 0.76 to 0.96 for the skull dentitions; all were statistically significant ( $p<0.0001$ ), indicating stronger agreement than can be expected by chance (Table III). Overall, there was an 86% agreement between all participants in charting present, missing, and restored teeth for both bitewing radiographs and skull dentitions. Participants used a minimum of 12 minutes and a maximum of 46 minutes to complete the activity and post-questionnaire, with an average time of 19.23 minutes ( $SD = 6.61$ ). Although not statistically significant ( $p = 0.351$ ), the trend of the data showed the average charting time was higher among non-experienced as compared to experienced participants [20.11 min ( $SD = 7.77$ ) vs. 17.73 min ( $SD = 3.74$ )].

**Table III. Kappa statistics for interrater reliability for dental charting of skulls and bitewing radiographs**

Skulls and Bitewing Radiographs:	Kappa	Standard Error	p value
Skull A	0.92	0.0085	<.0001
Skull B	0.96	0.0064	<.0001
Skull C	0.76	0.0064	<.0001
BWX 1	0.89	0.0054	<.0001
BWX 2	0.81	0.0055	<.0001
BWX 3	0.83	0.0060	<.0001

Students were asked to rate the level of difficulty they experienced while: 1) dental charting the radiographs, 2) dental charting the skull dentitions, and 3) matching the radiographs to the corresponding skulls. No statistically significant difference was found in levels of perceived difficulty between the experienced and non-experienced participants ( $p>0.05$  for all). However, over half of the participants reported experiencing a slight level of difficulty while dental charting the bitewing radiographs ( $n=16$ , 53.33%), and while dental charting the dentitions of the skulls ( $n=18$ , 60%). However, a majority (80%,  $n=24$ ) reported slight or no difficulty in matching the radiographic image sets with the corresponding skulls. Participants were also asked about their perceived confidence regarding their accuracy with matching the radiographs to the corresponding skulls. Although not statistically significant ( $p = 0.8498$ ), perceived confidence levels were slightly higher among participants with prior experience as compared to those without prior experience (81.82% vs. 78.95%, respectively). When asked about their willingness to volunteer as a member of a forensic comparison team in collaboration with forensic odontologists, the majority (93.33%,  $n=28$ ) indicated that they would consider it. The participants' perceived levels of difficulty, and confidence, along with their reported interest in dental forensics is shown in Table IV. When participants with previous experience in radiography were asked whether or not their formal dental hygiene coursework helped to improve skills, perceived improvement was indicated in the following areas: exposing radiographs (100%,  $n=11$ ), interpreting radiographs (90.91%,  $n=10$ ), recognizing dental restorations (100%,  $n=11$ ), and anatomical differences in teeth and bone (90.91%,  $n=10$ ).

## Discussion

This pilot study assessed senior dental hygiene students' ability to apply knowledge gained during their entry level dental hygiene curriculum, to match PM dental radiographs with human skull dentitions within a researcher-designed dental forensic scenario. All participants were able to match radiographic sets with the corresponding skulls with 100% accuracy and scored 91% or better when charting the dental

**Table IV. Descriptive statistics of levels of perceived difficulty and confidence**

Levels of perceived difficulty and confidence	Overall sample n=30 (%)	Prior experience n=11 (%)	No experience n=19 (%)	p value
<b>What level of difficulty did you experience while dental charting the three sets of bitewing radiographs?</b>				
None	13 (43.33%)	5 (45.45%)	8 (42.11%)	0.7402
Slight	16 (53.33%)	6 (54.55%)	10 (52.63%)	
Moderate	1 (3.33%)	0 (0%)	1 (5.26%)	
<b>What level of difficulty did you experience while dental charting the three skulls?</b>				
None	9 (30%)	4 (36.36%)	5 (26.32%)	0.8458
Slight	18 (60%)	6 (54.55%)	12 (63.16%)	
Moderate	3 (10%)	1 (9.09%)	2 (10.53%)	
<b>What level of difficulty did you experience while matching the three bitewing sets to the three corresponding skulls?</b>				
None	13 (43.33%)	7 (63.64%)	6 (31.58%)	0.1921
Slight	11 (36.67%)	2 (18.18%)	9 (47.37%)	
Moderate	6 (20.0%)	2 (18.18%)	4 (21.05%)	
<b>What level of confidence did you feel in your accuracy with matching the radiographs to the corresponding skulls?</b>				
Very confident	24 (80.0%)	9 (81.82%)	15 (78.95%)	0.8498
Moderately confident	6 (20.0%)	2 (18.18%)	4 (21.05%)	
Not confident at all	0 (0%)	0 (0%)	0 (0%)	
<b>In the future, would you consider volunteering on a forensic comparison team to aid forensic odontologists with identifying victim remains?</b>				
Yes	28 (93.33%)	10 (90.91%)	18 (94.74%)	0.6855
Maybe	2 (6.67%)	1 (9.09%)	1 (5.26%)	
No	0 (0%)	0 (0%)	0 (0%)	

evidence. Findings from this study are comparable to a previous study in which dental hygiene students were found to have an almost 90% accuracy rate.<sup>4</sup> The high level of accuracy demonstrated by these participants can be used to support efforts aimed at incorporating dental hygienists into multidisciplinary teams with forensic odontologists during MFIs. Furthermore, these results support the need for including forensics as part of dental and dental hygiene education as identified by Sivaneri et al.

The majority of participants (93.3%) indicated that they would consider volunteering as part of a MFI forensic comparison team, which concurs with a previous study by Bradshaw et al., where almost 92% of U.S. dental hygienists indicated willingness to serve in this capacity.<sup>15</sup> This pilot study helps fill gaps in the literature by assessing the skills obtained from a bachelor's degree dental hygiene program curriculum which could be successfully applied to identification match scenarios, and demonstrates the effectiveness of including this source of willing volunteers into future forensic comparison teams.

Inclusion of hands-on activities of matching skull anatomy with radiographs can be incorporated into the radiology course curriculum in dental hygiene programs. These activities would allow students the opportunity to build the conceptualization skills to better understand how unique anatomical features produce unique images. This pattern recognition skill has been identified by several researchers as one that could be learned through simulated activities similar to the design of this pilot study.<sup>16,17</sup> Pinchi et al. supports the inclusion of comparative activities for dental radiology coursework in forensic training, stating that it increases the performance of volunteers with dental education over non-dental volunteers.<sup>7</sup>

No statistically significant differences were found in the charting or identification match skills between participants with and without prior radiography experience in this pilot study. It is possible that the two semesters of radiology and three semesters of clinical curriculum completed by the participants included enough coursework so that the skills of non-experienced participants were comparable to experienced participants; yielding high accuracy for both. The vast majority of the participants in the pilot study reported slight to no difficulty when charting the radiographs, charting the skulls, and deciding on the matches. Considering these results, it is not surprising that the majority of the participants reported being very confident (80%) or moderately confident in their performance (20%).

This pilot study had limitations. The convenience sample was small and limited to one dental hygiene baccalaureate-degree granting institution. The pilot study was researcher-designed and not in complete alignment with other dental forensic study designs. Repeating previously published dental forensic studies is difficult for several reasons. There is a lack of standardization among the designs of dental forensic studies regarding the materials, methods, and participants. Second, dental features of the radiographs and skulls will be unique to each study. Third, the inclusion of dental hygienists in dental forensic research studies has been lacking.

The current study was limited to PM bitewing sets and did not include AM radiographs. This could be a limitation when considering that AM radiographs and a full mouth series of radiographs would also provide additional detail useful in forensic dentistry. Wenzel et al. also found that the ability of the participants to make matches increased with periapical images as compared to bitewings.<sup>16</sup> Some studies have been designed without AM radiographs, as they are not always available for forensic cases as cited in the ABFO Diplomates Reference Manual<sup>22</sup> and by Bux et al.<sup>21</sup> This supports the rationale for designing research studies requiring participants to rely on PM radiographs as the primary identification tool, which was a feature of this pilot study.

Another limitation was participants did not include qualifications of their answers to the identification matches to indicate degrees of probability. Not using qualification categories of “positive identification, possible identification, insufficient evidence, and exclusion,” may have impacted the generalizability of the results. According to Pinchi et al., confidence reported by forensic odontologists relates to the rater’s assignment of the likelihood of the positive match as it relates to a “probable” degree, rather than actual match accuracy.<sup>7</sup> Therefore, the cognitive bias of the participants

cannot be compared to findings of forensic odontologists from other studies.

Dental hygienists have shown evidence of being interested and committed to supporting forensic dentistry in their communities when the availability of forensic odontologists is limited.<sup>15</sup> Still, more evidence of the effective utilization of dental hygienists as a supportive adjunct for DVI is needed. Future studies should include large sample sizes of dental hygienists from areas throughout the United States, a variety of simulated forensic scenarios, and include students and graduates from a variety of dental hygiene education programs.

## Conclusions

Results from this pilot study demonstrate that dental hygiene students were able to match postmortem skull dentitions and radiographs with good interrater reliability and that they did not differ statistically for charting time, perceived difficulty, or confidence regardless of previous experience in dental radiography. A high level of agreement and accuracy among raters for dental charting and matching indicates dental hygienists are knowledgeable and well suited to work in a forensic-based capacity. Education in records comparison can help prepare dental hygienists for activities related to dental forensic victim identification. More research is needed to utilize the skills of dental hygienists related to dental forensics. Published reports of pedagogy used to teach forensic dentistry could aid future research in developing study designs to test educational best practices.

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## References

1. Bhullar KK, Bhullar RS, Balagopal S, et al. Evaluation of dental expertise with intra-oral peri-apical view radiographs for forensic identification. J Forensic Dent Sci.2014; 6(3): 176-81.

2. Hermsen KP, Johnson JD. A model for forensic dental education in the predoctoral dental school curriculum. *J Dent Educ.* 2012; 76(5): 553-61.
3. Gorza L, Manica S. Accuracy of dental identification of individuals with unrestored permanent teeth by visual comparison with radiographs of mixed dentition. *Forensic Sci Int.* 2018; 289(2018): 337-43.
4. Sholl SA, Moody GH. Evaluation of dental radiographic identification: an experimental study. *Forensic Sci Int.* 2001; 115(2001): 165-9.
5. Sweet D. Forensic dental identification. *Forensic Sci Int.* 2010; 201(2010): 3-4.
6. Tohnak S, Mehnert AJH, Mahoney M, Crozier S. Synthesizing dental radiographs for human identification. *J Dent Res.* 2007; 86(11): 1057-62.
7. Pinchi V, Norelli GA, Caputi F, et al. Dental identification by comparison of antemortem and postmortem dental radiographs: influence of operator qualifications and cognitive bias. *Forensic Sci Int.* 2012; 222(2012): 252-5.
8. Stoeckel DC, Merkley PJ, McGivney J. Forensic dental training in the dental school curriculum. *J Forensic Sci.* 2007; 52(3): 684-6.
9. Rawson R, Nelson B, Koot A. Mass disaster and the dental hygienist: the MGM fire. *J Dent Hyg.* 1982; 57:12-8.
10. Brannon LM, Connick CM. The role of the dental hygienist in mass disasters. *J Forensic Sci.* 2000; 45(2): 381-3.
11. Ferguson DA, Sweet DJ, Craig BJ. Forensic dentistry and dental hygiene: how can the dental hygienist contribute? *Probe.* 2008; 42(4): 203-11.
12. Nuzzolese E, Lepore MM, Cukovic-Bagic I, et al. Forensic sciences and forensic odontology: issues for dental hygienists and therapists. *Int Dent J.* 2008; 2008(58): 342-8.
13. Newcomb TL, Bruhn AM, Giles B. Mass fatality incidents and the role of the dental hygienist: are we prepared? *J Dent Hyg.* 2015; 89(3): 143-51.
14. Newcomb TL, Bruhn AM, Ulmer LH, Diawara N. Performance of dental hygiene students in mass fatality training and radiographic imaging of dental remains. *J Dent Hyg.* 2015; 89(5): 313-20.
15. Bradshaw BT, Bruhn AP, Newcomb TL, et al. Disaster preparedness and response: a survey of U.S. dental hygienists. *J Dent Hyg.* 2016; 90(5): 313-22.
16. Wenzel A, Richards A, Heidmann J. Matching simulated antemortem and postmortem dental radiographs from human skulls by dental students and experts: testing skills for pattern recognition. *J Forensic Odontostomatol.* 2010; 28(1): 5-12.
17. Zohn HK, Dashkow S, Ascheim KW, et al. The odontology victim identification skill assessment system. *J Forensic Sci.* 2010; 55(3): 788-91.
18. Page M, Lain R, Kemp R, Taylor J. Validation studies in forensic odontology – part 1: accuracy of radiographic matching. *Sci Justice.* 2018; 58(2018): 185-90.
19. Sivarneri M, Wiener CR, Shockey AKT, Waters C. Dental student skills in matching radiographs for forensic identification and in forensic knowledge. *J Biomed Educ.* 2018; 2018(4389259): 1-5.
20. Weems RA, Delattre VF, Senn DR, Sweet D. ABFO model of curricular topics for forensic odontology [Internet]. Reno (NV): American Board of Forensic Odontology; 2018 [2006 Feb; cited 2018 Dec 17]. Available from: <https://asfo.org/forensic-educators/>
21. Bux R, Heidemann D, Enders M, Bratzke H. The value of examination aids in victim identification: A retrospective study of an airplane crash in Nepal in 2002. *Forensic Sci Int.* 2006; 164(2006): 155-8.
22. American Board of Forensic Odontology. ABFO diplomats reference manual [Internet]. Reno (NV): American Board of Forensic Odontology; 2018 [updated 2017 Mar; cited 2018 Jan 29]. Available from: <http://abfo.org/resources/abfo-manual/>
23. Fleiss JL. Statistical methods for rates and proportions. 3<sup>rd</sup> ed. New York: John Wiley & Sons, Inc.; 2003. 768 p.

## Adolescents' Perceived Risk of Harm Due to Smoking: The role of extracurricular activities

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### Abstract

**Purpose:** Tobacco use initiated during adolescence often leads to continued use in adulthood. There are multiple factors influencing initiation, including low perceived risk of harm. Adolescents involved in school-based extracurricular activities have opportunities to interact with coaches, leaders, and group supervisors who may influence their perception of risk. The purpose of this study was to examine the role of extracurricular activities and adolescents' perceived risks of harm of tobacco use, utilizing an existing dataset.

**Methods:** The 2016 National Survey on Drug Use and Health (NSDUH) dataset was used for a cross-sectional study of youth, ages 12 to <18 years. Adolescents involved in one or more school-based, extracurricular activities were compared with adolescents involved in no activities. The key variable was the response to the NSDUH question regarding perceived risk of harm from daily smoking ( $\geq 1$  packs of cigarettes). Chi-square tests and multinomial logistic regression were used to analyze the data.

**Results:** At the time of the 2016 NSDUH study period, among the adolescents aged 12 to <18 years (n=4,308), 17.5% indicated that they did not participate in any extracurricular activities and 10.6% reported no/ slight perceived risk of harm associated with tobacco use. Adolescents who did not participate in extracurricular activities were more likely to report no/ slight risk of harm from smoking (Adjusted Odds Ratio, AOR= 2.21 [95%CI: 1.62, 3.02]) as opposed to the perception of great risk of harm.

**Conclusion:** Adolescents who are not involved in extracurricular activities are more likely to endorse the perception that cigarettes have no/ slight risk of harm. School-based extracurricular activities may provide unintended benefits to adolescents; health care professionals, including dental hygienists, should be aware of this associated health benefit.

**Key words:** adolescent smoking, perceived health risk, tobacco use, extracurricular activities, dental public health

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### Introduction

Adolescence, the life stage of increasing independence, development, and change, is also a period associated with increased risk-taking behaviors.<sup>1</sup> Adolescent autonomy often occurs during the same time as reduced adult supervision. There are risk-taking, novelty-seeking, independence-seeking behaviors during adolescence, that theoretically increase success in separating from the family, transitioning into adulthood, and finding a mate.<sup>1</sup> However, this developmental pattern may have consequences that are at odds with modern life, such as living longer with a parent or parents, being financially dependent upon one's family longer, and selecting a mate later in life.<sup>1</sup> Opportunities frequently arise during

adolescence to initiate or engage in risk-taking behaviors, some of which may be biologically driven, that would not be sanctioned by parents/guardians/other adults. These risk-taking behaviors include the unhealthful use of a wide range of substances, particularly alcohol and tobacco. Research has shown that adolescent risk-taking behaviors increase in the presence of peers, even when the adolescent has been provided information regarding negative outcomes.<sup>2</sup> Adolescents engaging in inappropriate risk-taking behaviors pose concern to their parents/guardians and other caring adults, including counselors, teachers, and health care providers.<sup>3</sup>

There are numerous negative health consequences associated with tobacco use, including smoking-related cancers, cardiovascular and metabolic diseases, pulmonary disease, and conditions associated with negative pregnancy and childbirth outcomes.<sup>4</sup> Additional consequences include lung cancer and coronary heart disease from secondhand smoke as well as fires.<sup>4</sup> Some of the specific oral health implications of tobacco use include oral cancer, periodontal disease, tooth loss, gingivitis, halitosis, and palatal petechiae. Since 1964, over 20 million deaths in the United States (US) have been attributed to smoking.<sup>4</sup> Over 90% of adult smokers began using tobacco before the age of 18.<sup>4</sup> It is also concerning that 68.9% of cigarette smokers who ever tried a cigarette just once, progressed to daily smoking.<sup>5</sup> Tobacco use remains a major public health issue and is of particular relevance to oral health care professionals. Overall health as well as oral health are impacted by tobacco use and dental professionals have been called on to promote never beginning to use tobacco, as well as tobacco cessation, through a variety of programs.

Considering the high conversion rate, adolescence is an important time to address and reduce tobacco experimentation.<sup>5</sup> An increase in activities, with adult oversight of adolescent time, may be helpful in reducing the conversion rate. Extracurricular activities, such as sports, cheerleading, choir, band, student government, and clubs all have adult coaches, leaders, and group supervisors. Sports participation, recreational physical activity, and physical education classes have been shown to have the potential for preventing or delaying unhealthful use of harmful substances.<sup>6</sup>

While a number of studies have examined the specific relationship between sports and unhealthful substance use, results are inconclusive.<sup>7-9</sup> Some researchers identified a lower use of cigarettes in adolescents involved in sports as compared with adolescents who were not involved with sports.<sup>6,10</sup> However, other studies have indicated that the protective effects are dependent on the type of sport, such as the non-contact sports of cross-country, gymnastics, swimming, tennis, track and volleyball. Negative effects have been found in high-contact sports such as football, wrestling, hockey, and lacrosse.<sup>11</sup> In a meta-analysis of tobacco use among male high school athletes, sports participation was shown to be a predictor for smokeless tobacco use but not cigarette use.<sup>12</sup>

In regards to other extracurricular activities, researchers who examined non-sport activities (music, choir, dance, band, and clubs), as well as sports, found that students, ages 10 to 14 years, were less likely to use tobacco if they participated in team sports; while the role of other activities failed to reach significance.<sup>13</sup> Another study examining the role

of extracurricular activities, showed that adolescents participating in extracurricular activities were less likely to use tobacco; however, the effect of the activities diminished over time.<sup>14</sup>

The Health Belief Theoretical Model (HBTM) of Behavior is based on the concept that the likelihood of adopting preventive, healthful behaviors is influenced by demographic/socio-psychological variables.<sup>15</sup> According to the HBTM, individuals are willing to adopt or aspire to certain health-related behaviors or habits in order to avoid illness/sickness/poor health outcomes, if certain constructs are met. The HBTM of Behavior includes: the individual's perceptions of susceptibility to poor health consequences; severity of the consequences; benefits to complete the preventive, healthful behavior; barriers to take action to complete the healthful behavior; and the self-efficacy to accomplish the healthful behavior.

Two other features of HBTM of Behavior, cues to action to encourage an action, and modifying variables, such as demographic and psychosocial variables, also are recognized as influencing healthful behavioral practices. Perception of harm as it relates to health consequences of tobacco use is a variable of particular interest.<sup>16</sup> Perceived harm is recognized as a key component of several other behavioral health change theories, and is targeted in interventions. Risk perception is a critical determinant of health behavior. Successful interventions include changing these perceptions to improve health behaviors.<sup>16</sup>

Adolescence is a formative period and an opportune time to engage change; it is possible that by modifying risk perception in adolescence through school-based activities will prevent or delay future tobacco use. The purpose of this study was to determine if there is an association between adolescents participating in extracurricular activities at school and their perception of harm from smoking ≥1 packs of cigarettes daily.

## Methods

The study received approval as a non-human subject exempt study (secondary data analysis) from the West Virginia University Institutional Review Board (protocol number: 1801928895). The data source was obtained from the publicly available 2016 National Survey on Drug Use and Health (NSDUH) Center for Behavioral Health Statistics and Quality, 2017.<sup>17,18</sup> Researchers at the Center for Behavioral Health Statistics and Quality conduct a yearly survey of civilian, non-institutionalized residents in the US, ages 12 years and above, concerning tobacco, alcohol, and other substance use, through in-person interviews at the participant's

residence, following an introductory letter.<sup>17,18</sup> States within the US were the first level of stratification in the sample. Each state was then further stratified into equally populated sampling regions, census tracks, census block groups, area segments and dwelling units; sample sizes were proportional to the state population.<sup>17,18</sup> Participants were then screened and interviewed; data were encrypted and transmitted to the contracted data collection/analysis corporation.<sup>17,18</sup> Interviews were randomly selected for verification, after which the data were cleaned; imputations were made as necessary; and analysis weights were created (Center for Behavioral Health Statistics and Quality, 2017).<sup>17,18</sup>

### **Study design**

This study used a cross-sectional design; researchers conducted a secondary data analysis of existing data. Questionnaire data collected from the 2016 NSDUH were used for analysis. Inclusion criteria were participants between the ages 12 to less than 18 years; participants who responded to the question concerning perception of risk of harm from smoking one or more packs of cigarettes per day; and, participants who responded to the question regarding number of school-based extracurricular activities in which they participated. There were 4,308 eligible participants.

### **Measures**

The outcome variable was based on the NSDUH question: “How much do people risk harming themselves physically and in other ways, when they smoke one or more packs of cigarettes per day?”<sup>17,18</sup> The raw data were presented with the potential responses of “no risk; slight risk; moderate risk; and, great risk.” Participants were grouped into three categories: 1) no/slight risk of harm; 2) moderate risk of harm; and, 3) great risk of harm. The primary independent variable of interest was school-based extracurricular activities from the NSDUH question: “During the past 12 months, in how many different kinds of school-based activities, such as team sports, cheerleading, choir, band, student government, or clubs, have you participated?”<sup>17,18</sup> The raw data were presented with the potential responses of “none; one; two; and, three or more.” The response was dichotomized to no activities, and ≥1 activities.

Other available variables were considered in the study with regards to the HBTM of Behavior. The following were chosen relating to the theory’s inclusion of demographic/socio-psychological variables: sex (female, male); age in years (12-13, 14-15, 16-17); family income level (less than \$20,000, \$20,000-\$49,999, \$50,000-\$74,999, \$75,000 and above); metropolitan/non-metropolitan residence (large metropolitan, small metropolitan, non-metropolitan); and parental support (a summative scalar variable). The

summative parental support variable was based upon never, seldom, sometimes, and always responses (coded 1, 2, 3, 4, respectively) which were added to create a summative score from seven NSDUH parental involvement questions. The following variables were chosen in relationship to the HBTM of Behavior inclusion of perceived benefits minus perceived barriers: smoking status (current smoker; former smoker; never smoker) and sensation seeking/enjoyment in dangerous things (a summative scalar variable from four NSDUH questions) were included as factors related to risk assessment (Figure 1).

Smoking status was determined from the responses to the questions regarding whether the participant had ever smoked; negative responses were categorized into the never smoker group. If the participant responded with a positive response to the ever-smoking question, he or she was identified as a current smoker if he/she had smoked within the past 30 days. Participants were identified as a former smoker if it had been

**Figure 1. Interview items used to construct summative scores for parental support and sensation seeking\***

How often did your parents check on whether you had done your homework?
How often did your parents provide help with your homework when you needed it?
How often did your parents make you do chores around the house?
How often did your parents limit the amount of time you watched TV?
How often did your parents limit the amount of time you went out with friends on school nights?
How often did your parents let you know when you’d done a good job?
How often did your parents tell you they were proud of you for something you had done?
How often do you get a real kick out of doing things that are a little dangerous?
How often do you like to test yourself by doing something a little risky?
How often do you wear a seatbelt when you ride in the front passenger seat of a car?
How often do you wear a seatbelt when you drive a car? (only applies to respondents of driving age)

\*Summative parental support variable based on: never, seldom, sometimes, and always. Responses were coded 1, 2, 3, 4, respectively

more than 30 days since the last time he/she had smoked. Health insurance (yes, no) was included as a factor related to the HBTM of Behavior “inclusion of cues for healthful action.” Improved access to access to care through health insurance increases access to health-related information developed to cue healthful behavior change.

### Statistical analyses

Data analyses were conducted with SAS® version 9.3 (SAS Institute, Inc., Cary, NC). Variables were analyzed for frequency. A Chi-square test was completed to identify bivariate associations of the perception of harm from smoking  $\geq 1$  packs of cigarettes per day and the other categorical variables. Multinomial logistic regression was used to analyze the association among the variables. Analyses were adjusted for strata, design, and sample weights; significance level was  $p \leq 0.05$ .

## Results

The sample consisted of participants who were ages 12 to less than 18 years ( $n=4,308$ ). There was an equal distribution of sex (53.0% male, 47% female), and age (31.8% 12-13 years; 33.6% 14-15 years; 34.7% 16-17 years). The majority of the adolescents had health insurance (95.8%) and self-identified as never smokers (84.0%). Approximately half were non-Hispanic white (52.1%) and lived in large metropolitan areas (51.3%).

There were 17.5% of adolescents who reported no school-based extracurricular activities. In terms of perception of the risk of harm from smoking  $\geq 1$  packs of cigarettes per day, 10.6% reported there was no/ slight risk of harm, 20.3% reported moderate risk of harm, and 69.1% who reported great risk of harm associated with smoking  $\geq 1$  packs of cigarettes per day. Sample demographics are shown in Table I.

Results of bivariate Chi Square analyses on the variables of interest and the perceived risk of harm from smoking  $\geq 1$  packs of cigarettes per day are also presented in Table I. Significant differences were identified in school-based extracurricular activities when compared with race/ethnicity, age, family income, smoking, enjoyment of dangerous things, and parental support. Categories with the highest weighted percentages of “no/ slight risk” perceptions as compared with the lowest weighted percentages were found in participants with fewer extracurricular school-based activities (8.4% difference), Non-Hispanic blacks (8.7% difference), children ages 12-13 years (4.0% difference), participants from families with incomes less than \$20,000 (8.8% difference), and current smokers (5.1% difference).

Adolescents who had no extracurricular, school based-activities were shown to be more likely to consider smoking

to be either no/ slight risk or moderate risk, than great risk, as compared to cohorts with one or more extracurricular, school-based activity. The unadjusted odds ratio (UOR) was 2.29 [95% Confidence level {CI} 1.71, 3.06];  $p<.0001$ . The UOR for indicating moderate risk of harm from smoking as compared to great risk of harm from smoking was 1.33 [95%CI: 1.04, 1.72];  $p=0.024$ .

Multivariate logistic regression results are presented in Table II. In the analysis adjusted for sex, age, race, health insurance, smoking, residence, income, parental support and sensation seeking/enjoyment in dangerous things, the adjusted odds ratio (AOR) was 2.21 [95%CI: 1.62, 3.02]  $p<.0001$ , for no/ slight risk of harm from smoking as compared to great risk of harm from smoking. The AOR for moderate risk of harm from smoking as compared to great risk of harm was 1.23 [95%CI: 0.95, 1.61];  $p=0.107$ .

There was an association of the perception of no/ slight risk of harm from smoking as compared with great risk of harm in current smokers versus never smokers: UOR=1.90 [95%CI: 1.12, 3.23];  $p=0.0190$ ; AOR = 2.69 [1.58, 4.60];  $p=0.001$ . Similarly, current smokers versus never smokers were also more likely to endorse moderate, as compared with great risk of harm from smoking: UOR= 1.77 [95%CI: 1.26, 2.48];  $p=0.0190$ ; AOR= 2.06 [95% CI: 1.48, 2.85];  $p <.0001$ . For former smokers versus never smokers, the perception of no/ slight risk of harm from smoking as compared with great risk of harm had: UOR = 1.13 [95%CI: 0.64, 1.99];  $p=0.6787$ ; and the AOR=1.43 [95%CI: 0.79, 2.58];  $p=0.232$ . For former smokers versus never smokers and the perception of moderate risk of harm as compared with great risk of harm, the odds ratios were: 1.34 [95%CI: 1.01, 1.79];  $p=0.0459$ ; and the AOR=1.41 [95%CI: 1.02, 1.96];  $p=0.039$ . Also, current smokers were more likely to have no versus  $\geq 1$  school-based extracurricular activities than never smokers: UOR = 2.70 [95%CI: 1.92, 3.80];  $p<.0001$ ; AOR= 1.99 [95%CI: 1.37, 2.89];  $p<.001$ . Former smokers were more likely than never smokers to have no versus  $\geq 1$  school-based extracurricular activities than never smokers: UOR= 1.98 [1.46, 2.69];  $p<.0001$ ; AOR= 1.86 [95%CI: 1.34, 2.59];  $p<.0001$ .

## Discussion

This study examined adolescents’ perception of risk of harm from daily smoking of  $\geq 1$  packs of cigarettes and the role of school-based extracurricular activities. Adolescents who did not participate in any school-based extracurricular activities were more likely to report no/ slight risk of harm from smoking as compared to adolescents who participated in one or more school-based extracurricular activities. These

**Table I. Sample demographics (2016 NSDUH<sup>17,18</sup>)**

	Total sample		Perception of risk of harm of ≥ 1 packs cigarettes/day						<i>p</i> -value
			No/slight risk Smoking harm		Moderate risk Smoking harm		Great risk Smoking harm		
	n 4,308	Wt %* 100	n 423	Wt %** 10.6	n 835	Wt %** 20.3	n 3,050	Wt %** 69.1	
<b>Sex</b>									<b>0.182</b>
Female	2,013	47.0	193	9.9	401	21.5	1,419	68.6	
Male	2,295	53.0	230	11.2	434	19.2	1,631	69.6	
<b>Race/Ethnicity</b>									<b>&lt;.0001</b>
Non-Hispanic White	2,252	52.1	159	7.7	378	16.6	1,715	75.6	
Non-Hispanic Black	622	15.2	89	16.4	144	24.9	389	58.8	
Hispanic	920	23.0	115	13.4	208	25.9	597	61.7	
Other	514	9.7	60	10.1	105	21.6	349	62.3	
<b>Age in years</b>									<b>0.038</b>
12-13	1,395	31.8	168	13.1	259	18.9	968	68.0	
14-15	1,485	33.6	128	9.7	277	20.3	1,080	70.0	
16-17	1,428	34.7	127	9.1	299	21.5	1,002	70.0	
<b>Family income level</b>									<b>&lt;.0001</b>
Less than \$20,000	841	18.6	124	15.4	200	24.5	517	60.1	
\$20,000 - \$49,999	1335	30.8	142	11.4	281	22.8	912	65.7	
\$50,000 - \$74,999	673	15.1	72	12.2	103	16.2	498	71.6	
\$75,000 and above	1,459	35.5	85	6.6	251	17.6	1,123	75.8	
<b>Health Insurance</b>									<b>0.083</b>
Yes	4,148	95.8	400	10.4	799	20.0	2,949	69.5	
No	160	4.2	23	14.4	36	25.8	101	59.8	
<b>Metropolitan/non-metropolitan</b>									<b>0.573</b>
Large metropolitan	1,763	51.3	188	11.5	363	20.4	1,212	68.1	
Small metropolitan	1,581	31.6	134	9.2	299	19.8	1,148	71.0	
Non-metropolitan	964	17.1	101	10.3	173	20.8	690	68.8	
<b>Smoking</b>									<b>0.008</b>
Current smoker	282	5.9	38	15.3	73	27.9	171	56.7	
Former smoker	457	10.2	45	11.0	101	23.9	311	65.1	
Never smoker	3,569	84.0	340	10.2	661	19.3	2,568	70.5	
<b>Extracurricular school-based activities***</b>									<b>&lt;.0001</b>
No activities	758	17.5	117	17.5	166	22.4	485	60.1	
1 or more activities	3,540	82.4	306	9.1	669	19.8	2,565	71.1	
<b>Parental support (mean, SE)</b>	13.41	(0.1)	12.7	(0.3)	13.4	(0.2)	13.5	(0.1)	<b>&lt;.0001</b>
<b>Sensation seeking (mean, SE)</b>	5.07	(0.04)	4.97	(0.1)	5.00	(0.01)	5.1	(.1)	<b>&lt;.0001</b>

\* wt% = weighted column percent

\*\*wt% = weighted row percent;

\*\*\*School activities = team sports, cheerleading, choir, band, student government, clubs, etc.

**Table II. Odds Ratios and Multinomial Logistic Regression of School Activities on Increasing Perception of Risk of Harm (2016 NSDUH, n=4,308)**

	Unadjusted Logistic Regression Odds ratio [95% Confidence Interval] <i>p</i> -value		Adjusted Logistic Regression Adjusted odds ratio [95% confidence Interval] <i>p</i> -value	
	Moderate risk to smoking OR [95% CI] <i>p</i> -value	No/ slight risk to smoking OR [95% CI] <i>p</i> -value	Moderate risk to smoking OR [95% CI] <i>p</i> -value	No/ slight risk to smoking OR [95% CI] <i>p</i> -value
<b>Extracurricular**</b>				
No activities	1.33 [1.04, 1.71] 0.024	2.29 [1.71, 3.06] <.0001	1.23 [0.95, 1.61] 0.107	2.21 [1.62, 3.02] <.0001
1 or more	Reference group	Reference group	Reference group	Reference group
<b>Sex</b>				
Male			0.91 [0.76, 1.08] 0.276	1.23 [0.88, 1.46] 0.343
Female			Reference group	Reference group
<b>Race/ethnicity</b>				
Hispanic			1.77 [1.27, 2.46] 0.001	1.94 [1.33, 2.84] 0.001
Non-Hispanic black			1.84 [1.30, 2.60] 0.001	2.51 [1.67, 3.76] <.0001
Other			1.46 [1.03, 2.07] 0.033	1.51 [0.96, 2.335] 0.071
Non-Hispanic white			Reference group	Reference group
<b>Age</b>				
12-13			0.94 [0.71, 1.25] 0.669	1.81 [1.21, 2.70] 0.005
14-15			0.96 [0.75, 1.23] 0.735	1.26 [0.86, 1.84] 0.2274
16-17			Reference group	Reference group
<b>Family income level</b>				
<\$20,000			1.28 [0.96, 1.73] 0.095	1.81 [1.28, 2.55] 0.001
\$20,000-\$49,999			1.21 [0.95, 1.54] 0.125	1.50 [1.03, 2.17] 0.034
\$50,000-\$74,999			0.87 [0.59, 1.28] 0.478	1.69 [1.17, 2.44] 0.007
≥\$75,000			Reference group	Reference group
<b>Insurance</b>				
No			1.34 [0.77, 2.32] 0.289	1.50 [0.99, 2.26] 0.054
Yes			Reference group	Reference group
<b>Metropolitan/non-metropolitan</b>				
Non-metropolitan			1.10 [0.77, 1.58] 0.584	0.90 [0.63, 1.28] 0.551
Small metropolitan			0.98 [0.78, 1.24] 0.886	0.76 [0.56, 1.02] 0.070
Large metropolitan			Reference group	Reference group
<b>Smoking</b>				
Current			2.06 [1.48, 2.85] <.0001	2.69 [1.58, 4.60] 0.001
Former			1.41 [1.02, 1.96] 0.039	1.43 [0.79, 2.58] 0.232
Never			Reference group	Reference group
<b>Parental support</b>				
Sensation seeking			0.98 [0.96, 1.01] 0.199	0.95 [0.92, 0.99] 0.010

\*Adjusted model adjusted for sex (female, male); race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other); age in years (12-13, 14-15, 16-17); family income level (<\$20,000, \$20,000-\$49,999, \$50,000-\$74,999, \$75,000 and above); health insurance (yes, no); metropolitan/non-metropolitan (large metropolitan, small metropolitan, non-metropolitan); smoking (current, former, seldom/never); parental support (scalar); and sensation seeking (scalar).

\*\*Extracurricular School Activities=team sports, cheerleading, choir, band, student government, clubs, etc.

results support the theory that an individual's perceived beliefs regarding risks of harm are factors in health behavior consequences, as proposed in the HBTM of Behavior.<sup>15</sup> Although not a focus of this study, associations were also found in the perception of no/slight risk of harm from smoking ≥1 packs of cigarettes per day in adolescent who identified as smokers when compared with non-smoking adolescents. Also, adolescent smokers and former adolescent smokers were more likely not to have any school-based extracurricular activities. Due to the nature of the interview questions posed in the data source, it was not possible to determine the type of activity (non-sport, contact sport, or team sport) nor the amount of time that was associated with the activity. Nevertheless, there was a difference in perceptions between the groups not participating and the groups participating in school-based extracurricular activities.

Considering that the vast majority of adult smokers (90%) report having begun smoking as adolescents or pre-teens,<sup>19</sup> there is a critical need to determine effective prevention interventions and opportunities. Encouraging extracurricular, school-based activities may be helpful in shaping perceptions about smoking and ultimately influence health behavior. Understanding adolescent perceptions, knowledge, attitudes, and behaviors with respect to tobacco use, is important in developing interventions.

There are few studies in the literature regarding the effects of school-based extracurricular activities on the perceived beliefs of harm in smoking cigarettes, for direct comparisons with the results of this study. In a literature review on the reasons why children smoke<sup>20</sup> only one study was cited regarding the potential protective aspects of sports and regular physical activity classes.<sup>6</sup> In the study by Dunn, an association was found between physical activity and substance abuse behaviors among high school students, similar to the findings of this study.<sup>6</sup> The protective effects of sports and other extracurricular activities has been reported in a variety of studies.<sup>6,10,14</sup> El-Toukhy et al. examined smoking related beliefs using the 2012 National Youth Tobacco Survey data, and found that over two-thirds of all youth surveyed strongly agreed that all tobacco products were dangerous.<sup>21</sup> Results from this study were consistent with the findings observed by El-Toukhy et al., in that 69.3% of the participants believed there was a perceived of risk of harm from smoking ≥1 packs of cigarettes per day.

Adolescents are influenced by the character of the setting in which they live and spend their time, including their social setting.<sup>22</sup> Therefore, safe settings, such as those ostensibly provided in school-based extracurricular activities, can make a difference in harm reduction in adolescents.<sup>22</sup> School-

based extracurricular activities also have the potential to help adolescents develop self-regulating skills. Sports, music, and other activities require discipline, practice and self-regulation. Higher behavioral self-regulation has been associated with reduced odds of initiating tobacco use.<sup>23</sup>

Results from this study may be useful in informing public health interventions and messaging regarding the underlying importance of school-based extracurricular activities beyond the social, physical, or mental benefits that are commonly associated with these activities. Many school-based extracurricular programs have been cut for budgetary reasons; however, their intrinsic benefits should be considered. Structural, school-level participation in organized activities were shown to be negatively associated with smoking in a study of Japanese boys.<sup>24</sup> Tobacco cessation interventions are needed and programs are being developed to help teachers and coaches to deliver self-efficacy programs for tobacco use prevention in sports.<sup>25</sup> Similar workshops are needed for adults who work with adolescents in similar extracurricular activities.

### ***Study strengths and limitations***

A large, nationally representative, current data source was used for the sample population in this study. While the retrospective study design did not permit causality to be determined, there was a strong association between the adolescents who were involved in school-based extracurricular activities and their perceived risk of harm from smoking as compared with adolescents who were not. The study design was limited by the nature of the questions posed to the participants. The question regarding extracurricular activities was restricted to school-based activities. Adolescents may also participate in community-based activities, church-based activities, clubs, and other activities not sponsored by schools that were not captured in this study. In addition, the nature of the question in the data source, which included all school-based activities, did not allow for stratification by contact/non-contact sports, or all-encompassing versus minor participation in the activities. It was not possible to determine whether adult supervision was a mediator in the results or if other smoking patterns would have influenced the findings.

This study only addressed the association of extracurricular activities and the perceived harm of smoking one or more packs of cigarettes per day, a smoking pattern which is not common among adolescents. The data collected did not address other tobacco products, such as smokeless tobacco nor the use of electronic cigarettes. Other studies have indicated an increased risk of smokeless tobacco use among youth engaging in athletics, due to lower perceived risk of harm from this product,<sup>26, 27</sup> and the emulation of professional

athletes who use smokeless tobacco.<sup>28</sup> Similarly, other studies have indicated that the relatively common use of electronic cigarettes is more likely to occur among youth who participate in intramural, competitive, and team sports.<sup>29</sup>

Adolescents not involved in school-based extracurricular activities are more likely to endorse that perception that cigarettes have no/ slight risk of harm rather than great risk of harm than their cohorts who are engaged in one or more school-based extracurricular activities. School-based extracurricular activities may provide unintended benefits to adolescents concerning tobacco use. Further research is needed to address potential confounding factors that may contribute to the perception of harm including family, regional differences, types of activities, and influences/education of coaches or other adult supervisors. Additionally, other forms of tobacco use should be examined. The widespread use of electronic cigarettes, and the ability of the user to easily conceal them, are factors for researchers to explore. Understanding the use of smokeless tobacco products, snuff, snus, cigars, pipes, and hookahs by adolescents would also provide important knowledge to inform policies and provide healthcare providers with information critical for anticipatory guidance.

Health care practitioners in general, have opportunities to speak one-on-one with adolescents within their provider roles. Dental hygienists, as prevention-based health care professionals, have a unique role with the opportunity to develop trust and rapport with patients, especially adolescents. Tobacco use and prevention strategies can be initiated, discussed and reinforced regularly, along with tobacco cessation practices within the dental hygiene care appointment. As health care providers, dental hygienists are invested in their patients' health and well-being. Given the frequency of visits for dental hygiene care, providers have the opportunity to discuss the additional benefits of extracurricular activities, which could lead to delaying or preventing tobacco initiation. Dental hygiene care appointments can provide opportunities to present information concerning risk perception, and support patients in making healthful life choices.

## Conclusion

Adolescents who are not involved in extracurricular activities are more likely to endorse the perception that cigarettes have no/ slight risk of harm. School-based extracurricular activities may provide unintended benefits to adolescents in promoting the perception that tobacco use is harmful to one's health.

## Disclosure

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## References

1. Casey BJ, Getz S, Galvan A. The adolescent brain. *Dev Rev*. 2008 Mar 1;28(1):62-77.
2. Smith B, Chein J, Steinberg L. Peers increase adolescent risk taking even when the probabilities of negative outcomes are known. *Dev Psychol*. 2014 May;50(5):1564-8.
3. Frydenberg E. Adolescent coping. New York: Routledge; 2018. 134 p.
4. US Department of Health and Human Services. The health consequences of smoking—50 years of progress: a report of the surgeon general [Internet]. Atlanta (GA): US Department of Health and Human Services, Centers for Disease Control and Prevention; 2014. [cited 2020 Jun 2]. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.653.9865&rep=rep1&type=pdf>
5. Birge M, Duffy S, Miler JA, Hajek P. What proportion of people who try one cigarette become daily smokers? A meta-analysis of representative surveys. *Nicotine Tob Res*. 2017 Nov 15;20(12):1427-33.
6. Dunn MS. Association between physical activity and substance use behaviors among high school students participating in the 2009 Youth Risk Behavior Survey. *Psychol Rep*. 2014 Jun;114(3):675-85.
7. Bedendo A, Noto AR. Sports practices related to alcohol and tobacco use among high school students. *Braz J Psychiatry*. 2015 Apr-Jun;37(2):99-105.

8. Peretti-Watel P. Sports and drugs: further interpretative hypotheses are necessary. *Addiction*. 2009 Jan;104:150-1.
9. Terry-McElrath YM, O'Malley PM, Johnston LD. Exercise and substance use among American youth, 1991-2009. *Am J Prev Med*. 2011 May 1;40:530-40.
10. Lee KT, Vandell DL. Out-of-school time and adolescent substance use. *J Adolesc Health*. 2015 Nov 30;57(5):523-9.
11. Veliz PT, Boyd CJ, McCabe SE. Competitive sport involvement and substance use among adolescents: a nationwide study. *Subst Use Misuse*. 2015 Jan 28;50(2):156-65.
12. Davis TC, Arnold C, Nandy I, et al. Tobacco use among male high school athletes. *J Adolesc Health*. 1997 Aug 1;21(2):97-101.
13. Adachi-Mejia AM, Chambers JJ, Li Z, Sargent JD. The relative roles of types of extracurricular activity on smoking and drinking initiation among tweens. *Acad Pediatr*. 2014 Jun 30;14(3):271-8.
14. Crispin LM, Nikolaou D, Fang Z. Extracurricular participation and risky behaviours during high school. *Appl Econ*. 2017 Jul 21;49(34):3359-71.
15. Janz NK, Becker MH. The health belief model: a decade later. *Health Educ Q*. 1984 Mar;11(1):1-47.
16. Ferrer R, Klein WM. Risk perceptions and health behavior. *Curr Opin Psychol*. 2015 Oct 1;5:85-9.
17. Center for Behavioral Health Statistics and Quality. 2016 NSDUH public use file codebook [Internet]. Rockville (MD): Substance Abuse and Mental Health Services Administration; 2017 [cited 2020 Jun 2]. Available from: [https://www.samhsa.gov/data/sites/default/files/NSDUH-MethodSummDefs-2016/NSDUH\\_MethodSummDefs-2016.htm](https://www.samhsa.gov/data/sites/default/files/NSDUH-MethodSummDefs-2016/NSDUH_MethodSummDefs-2016.htm)
18. Hunter D. National survey on drug use and health (NSDUH) 2016. methodological summary and definitions [Internet]. Research Triangle Park (NC): Center for Behavioral Health Statistics and Quality; 2017 [cited 2020 Jun 2]. Available from: [.https://www.samhsa.gov/data/sites/default/files/NSDUH-MethodSummDefs-2016/NSDUH-MethodSummDefs-2016.htm](https://www.samhsa.gov/data/sites/default/files/NSDUH-MethodSummDefs-2016/NSDUH-MethodSummDefs-2016.htm).
19. Centers for Disease Control and Prevention. Smoking and tobacco use: youth and tobacco use [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2019 [cited 2020 Jun 2]. Available from: [https://www.cdc.gov/tobacco/data\\_statistics/fact\\_sheets/youth\\_data/tobacco\\_use/index.htm](https://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/tobacco_use/index.htm)
20. Williams RJ, Knight RA, Wills TA. Why children smoke in 2015 and prospects for stopping them: a review of current literature. *Curr Cardiov Risk Rep*. 2015 Oct 1;9(10):45.
21. El-Toukhy S, Choi K. Smoking-related beliefs and susceptibility among United States youth nonsmokers. *J Adolesc Health*. 2015 Oct 31;57(4):448-50.
22. Blum RW, Rinehart PM. Reducing the risk: connections that make a difference in the lives of youth [Internet]. Bethesda (MD): U.S. Department of Education (ERIC); 2019 [cited 2019 Sept 10]. Available from: <https://files.eric.ed.gov/fulltext/ED412459.pdf>
23. deBlois ME, Kubzansky LD. Childhood self-regulatory skills predict adolescent smoking behavior. *Psychol Health Med*. 2016 Feb 17;21(2):138-51.
24. Takakura M. Relations of participation in organized activities to smoking and drinking among Japanese youth: contextual effects of structural social capital in high school. *Int J Public Health*. 2015 Sep 1;60(6):679-89.
25. Garnham-Lee K, Trigwell J, McGee CE, et al. Impact and acceptability of the coach and teacher training within a school-based sport-for-health smoking prevention intervention: SmokeFree Sports. *J Child Adolesc Subst Abuse*. 2016 Nov 1;25(6):606-12.
26. Agaku IT, Singh T, Jones SE, et al. Combustible and smokeless tobacco use among high school athletes—United States, 2001–2013. *MMWR Morb Mortal Wkly Rep*. 2015 Sep 4;64(34):935-9.
27. Chaffee BW, Couch ET, Urata J. Predictors of smokeless tobacco susceptibility, initiation, and progression over time among adolescents in a rural cohort. *Subst Use Misuse*. 2019 Jun 7;54(7):1154-66.
28. Chaffee BW, Couch ET, Gansky SA. Adolescents' smokeless tobacco susceptibility by perceived professional baseball players' use. *J Public Health Dent*. 2018 Dec;78(1):5-8.
29. Milicic S, Piérard E, DeCicca P, Leatherdale ST. Examining the association between physical activity, sedentary behavior and sport participation with e-cigarette use and smoking status in a large sample of Canadian youth. *Nicotine Tob Res*. 2017 Nov 1;21(3):285-92.

# 2020 Dentsply Sirona/ADHA Graduate Student Research Abstracts

The following abstracts are from the participants of the 2020 Annual Dentsply Sirona/ADHA Graduate Student Clinician's Research Program. The purpose of the program, generously supported by Dentsply Sirona for the past 13 years, is to promote dental hygiene research at the graduate level. Dental hygiene post-graduate programs may nominate one student to participate and present their research at the Annual Conference of the American Dental Hygienists' Association. The following posters were submitted to the ADHA Annual Conference, held virtually, June 26-28, 2020.

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## Factors Associated with Burnout in California Dental Hygienists

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**Purpose:** To quantify the distribution of burnout, as identified by the Maslach burnout inventory (MBI), and to assess the key occupational factors associated with burnout in dental hygienist members of the California Dental Hygienists' Association.

**Methods:** A 36-item survey, consisting of questions assessing burnout, demographic information, clinical care and occupational environment, was electronically sent to dental hygienists who were members of the California Dental Hygienists' Association (n=2,211). Mean scores for each of the burnout subscales (emotional exhaustion-EE, depersonalization-DP, and personal accomplishment-PA) were computed using the MBI manual guidelines, and statistically related to the occupational factors.

**Results:** The response rate was 20.9% (n=443). Thirty percent (30.9%) of respondents reported burnout, as identified by the MBI guidelines; 30.0% of respondents reported high emotional exhaustion (scores $\geq$ 27) and 11.3% reported high depersonalization (scores $\geq$ 10). Only 41.1 reported low personal accomplishment. Emotional exhaustion and depersonalization decreased with increasing age categories (EE: F=5.78, p<0.05; DP: F=9.26, p<0.05). Respondents between the ages of 35-44 had the highest emotional exhaustion (EE=24.7) and depersonalization (DP=6.34). Respondents reporting higher levels of self-perceived appreciation at work

were more likely to have lower EE and DP (EE: F=5.12, p<0.05; DP: F=8.66, p<0.05).

**Conclusion:** Approximately 3 in 10 dental hygienists in this sample experienced burnout. Data indicate the importance of expressing well-deserved appreciation to colleagues and the need to develop educational programs to teach practicing dental hygienists as well as dental hygiene students, ways to prevent and alleviate the symptoms of stress that often lead to burnout.

## Dental hygienists' role in the opioid syndemic: Assessing attitudes, perceptions, and practices

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**Purpose:** The purpose of this study was to assess dental hygienists' role in recognizing opioid use disorder (OUD) and to determine the relationship between attitudes and perceptions, interprofessional collaboration, and level of training in evidence-based screening tools.

**Methods:** This cross-sectional study was conducted using the validated Drug and Drug Problems Perceptions Questionnaire (DDPPQ). The survey was distributed to a convenience sample of dental hygienists (n=197) using Texas Dental Hygienists' Association components' Facebook® pages, for seven weeks. Survey items included demographics, professional characteristics and employment, DDPPQ subscales related to attitudes and perceptions, interprofessional relationships, and training in evidence-based screening tools. Responses

collected in Qualtrics® were imported into SPSS® Version 25 for data analysis. Descriptive and inferential statistics were used to associate the data.

**Results:** The survey completion rate was 90.9% (n=179). Respondents' attitudes and perceptions were assessed by measuring the DDPPQ subscale results of role adequacy, role legitimacy, role support, and role motivation/ self-efficacy ( $p<0.01$ ). Only 3% of respondents reported working closely with other professionals; exhibiting significance to each subscale ( $p<0.01$ ). 13% of participants reported training in evidence-based screening tools for opioid abuse; group statistics found significant relationships to subscales of role adequacy, support, and motivation/ self-efficacy ( $p<0.05$ ).

**Conclusion:** Results from this study combined with existing research, indicate the need for increased interprofessional involvement and OUD education amongst practicing dental hygienists. Dental hygienists who perceive themselves as knowledgeable, prepared, and supported, are shown to exhibit increased security and commitment toward their evolving role; further promoting patient-centered comprehensive care.

### **Patients' Perspectives of Dental Hygienists' Social Intelligence on Self-Care Commitment: A person-centered model**

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developing others, leveraging diversity and political awareness. Means ranged from 6.0 to 6.55 for the Social Skills capabilities of influence, communication, leadership, change catalyst, conflict management, building bonds, collaboration and cooperation, and teamwork. Participants agreed or strongly agreed that all capabilities were highly influential on commitment to self-care. There was a statistically significant difference for gender ( $p=0.013$ ); females scored the capabilities higher than males. Thirteen definitions of the capabilities were constructed based on patients' perspectives.

**Conclusion:** A new Social Intelligence Self-Care Commitment Model was created by combining the study's results, the Client Self-Care Commitment Model, and person-centered care concepts. Educators should consider incorporating the capabilities and the new model into curricula for oral healthcare students to increase the potential for patient commitment to oral self-care.

### **Validation of a Grading Rubric Designed to Evaluate Reflective Ability of Predoctoral Dental Students**

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**Purpose:** The purpose of this study was to examine patients' perspectives regarding the Social Intelligence of dental hygienists that influence self-care commitment. Three null hypotheses were tested to determine differences between patient perspectives and recare interval, generation, and gender.

**Methods:** The University of Idaho's Human Subjects Committee approved this descriptive comparative study (IRB-FY2019-131). In the spring of 2019, patients (n=108) were surveyed at a bachelor's degree dental hygiene program's clinic after at least one 15-minute self-care education session. The self-designed questionnaire was tested for reliability and validity and required participants to rate two Social Intelligence abilities, Social Awareness and Social Skills, on a 7-point Likert scale. Thirteen related capabilities defined the two abilities.

**Results:** The means ranged from 6.4 to 6.6 for the Social Awareness capabilities of empathy, service orientation,

Purpose: The ability to reflect and self-assess are critical skills for healthcare providers. The Commission on Dental Accreditation (CODA) includes critical thinking in dental and dental hygiene accreditation standards and states that graduates must be competent in the use of critical thinking skills. Without the ability to reflect and self-assess, lifelong learning is less likely to be effective. However, self-reflection does not come naturally for students and is a skill that must be taught and learned. To assist dental and dental hygiene educators with reflective writing and self-assessment assignments, this study aimed to validate a grading rubric designed to measure students' reflective ability.

**Methods:** Dental students at the University of Missouri-Kansas City (UMKC) develop e-portfolios throughout their four years of dental school, completing assignments that require development of reflection and self-assessment skills. The final piece of the portfolio includes a global reflection discussing the achievement of program competencies.

UMKC faculty raters independently evaluated 106 dental student global reflections from the graduating class of 2018. Reflections were scored against a grading rubric adapted from the work conducted by O'Sullivan and Bain. The rubric ranged from Level 0 (does not respond to the assignment) to Level 5 (reconstructing).

**Results:** After multiple rounds of calibration, evaluation, and a final focus group, the analysis resulted in an intraclass correlation of .708. Collectively, ratings of the 106 global reflections ranged from 1.3 to 5.0 ( $M=3.1$ ,  $SD=0.66$ ).

**Conclusion:** Results from this study show that even with calibration, it is difficult to acquire consensus regarding students' levels of reflection and further supports the need to have a reliable instrument for measuring reflective ability.

### The Profession of Dental Hygiene: Pathways to career choice and influences on professional identity

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Hygiene, and Access had a significantly greater positive influence on Professional Members' professional identity ( $p=0.001$ ,  $p=0.028$ , and  $p=0.001$ , respectively). Student Members reported greater influence on their professional identity in the areas of patient care resources and support of their career ( $p=0.01$ ,  $p<0.001$ , respectively).

**Conclusion:** The desire to have a career in the health/dental field was the most influential factor for selecting the dental hygiene profession. ADHA's continuing education and evidence-based research resources most positively affects both members' professional identity.

### Attitudes of Virginia Dentists Toward Mid-Level Dental Providers

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**Purpose:** The purpose of this study was to determine perceptions of Virginia (VA) dentists toward mid-level dental providers, specifically dental therapists (DT), and determine whether membership in the American Dental Association (ADA) affected attitudes.

**Methods:** After IRB approval, data was collected with an online survey sent to 1,208 VA dentists. Participants responded to 11 Likert type scale questions ranging from 1 (strongly disagree) to 7 (strongly agree) assessing their attitudes toward DTs. Participants also responded to questions regarding the appropriate level of education and supervision of a DT, as well as five demographic questions. Statistically significant differences for Likert type scale questions were determined using a one-sample t-test.

**Results:** A response rate of 12% was obtained ( $n=145$ ). Most participants were males (73%), members of ADA (84%), and over the age of 40 (65%). Results suggest most participants did not perceive ( $M=1.90$ ,  $p<0.001$ ) that a DT was needed in Virginia, and did not support ( $M=2.08$ ,  $p<0.001$ ) legislation for a DT model. Most participants ( $M=2.01$ ,  $p<0.001$ ) were not comfortable having a dental therapist perform authorized procedures or ever employing one in their practice ( $M=1.82$ ,  $p<0.001$ ). Comfort having a DT perform authorized procedures ( $\beta=.63$ ,  $p<0.001$ ), but not years of practice  $\beta=-.09$ ,  $p=0.18$ ), was significantly associated with support for a DT. A lower tolerance towards DTs was associated with an increased likelihood of membership in the ADA ( $\beta=.14$ ,  $p=0.04$ ).

**Conclusions:** VA dentists surveyed have negative attitudes toward DTs. Findings support the need for more research with a larger, more diverse sample population.

### Student Incivility in Dental Hygiene Education: Faculty perceptions

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**Purpose:** Conflict and courtesy between college students and faculty have become increasingly common in higher education. Fallout from uncivil student encounters can have numerous effects on educators' overall health and has been shown to negatively impact learning environments. This research assessed the severity and frequency of student incivility in dental hygiene education and explored the relationship uncivil behavior has on faculty feelings of confidence, career satisfaction, and longevity.

**Methods:** Cross-sectional survey research was conducted among dental hygiene educators ( $n=601$ ) in the US and Canada using purposive and snowball sampling. The survey (47-item) was developed based on the literature and validated prior to administration. Spearman's correlation coefficient was used to assess the relationship between variables and mean item category scores and thematic analysis was used to identify themes for the open-ended questions.

**Results:** The survey completion rate was 78% ( $n=469$ ). Behaviors ranked mildly uncivil like eating/drinking in class occurred more frequently and incivility had less impact on faculty confidence with increased age ( $r=-.19$ ,  $p\leq 0.01$ ). The level of severity of behaviors did not impact educators; however, how often certain behaviors occurred had some effect. Contemptuous behaviors like using a disrespectful/sarcastic tone ( $r=.34$ ,  $.32$ ,  $.31$ ,  $p\leq 0.01$ ) had the most impact.

**Conclusion:** This study determined student incivility exists within dental hygiene education. The day-to-day, minor uncivil behaviors seemingly take a greater emotional toll than the occasional, highly uncivil encounter. Understanding how faculty perceive these behaviors may influence the development of management strategies, fostering a sense of career satisfaction for educators.

### Dental and Dental Hygiene Students' Knowledge and Attitudes Regarding Teledentistry

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**Purpose:** To identify the knowledge and attitudes about teledentistry among UNC Adams School of Dentistry (UNC ASoD) dental (DDS) and dental hygiene (DH) students in North Carolina (NC) where teledentistry is less developed in part because of policy restrictions.

**Methods:** A faculty presentation and video demonstration regarding teledentistry was followed by small group discussions and a large group debriefing session for an audience of dental and dental hygiene students at the UNC ASoD. Participants completed an optional electronic survey before and after the session. McNemar's matched pair test and Fishers exact test were used to compare the participants' pre-and post-intervention responses.

**Results:** Participants ( $n=44$ ) included 30 DH and 14 DDS students. A significant increase in the participants self-reported knowledge of teledentistry ( $p<0.01$ ) was found however there was no change in attitudes about adoption of teledentistry into the curriculum. There was a significant difference in regards to attitudes of DHs' role using teledentistry ( $p=0.04$ ) and 89% of students identified DH restricted scope of practice as a barrier to its implementation.

**Conclusion:** The educational session resulted in significant increase in knowledge and demonstrated positive attitudes toward the adoption of teledentistry into multiple facets of DDS and DH curriculum. A major barrier to its adoption into practice is the DH restricted scope of practice in NC.

## Digital Scan to Enhance Patient Education

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## Implant Maintenance Curriculum Among Dental Hygiene Programs in the United States

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**Purpose:** The purpose of this pilot study was to evaluate whether the use of a 3D intraoral scan as a visual aid, improves a patient's communication self-efficacy and risk-literacy concerning their periodontal disease status.

**Methods:** This pilot study used a parallel experimental research design and collected quantitative data through a pre-test and two post-tests for both groups. The Ask, Understand, Remember Assessment (AURA) survey was used to collect quantitative data pertaining to patient communication self-efficacy and the Protection Motivation Survey (PMS) was used to evaluate each patient's risk-literacy of their periodontal disease. The addition of four Likert-scale questions concerning experience with the periodontal chart was added to the control group. An additional eight questions were added to the experimental group's post-test concerning experience and understandability with the periodontal chart and 3D digital intraoral scan.

**Results:** Participant communication self-efficacy (AURA survey) in the 3D intraoral scan experimental group did not statistically improve compared to the control group. The change in risk-literacy (PMS questionnaire) for the pre- and post-tests and individual questions between the control and experimental groups was not statistically significant. A high correlation ( $p < 0.03$ ;  $n=21$ ) was found between an elevated PMS post-test #1 score and elevated experience post-test score for the whole group, indicating that a high risk-literacy score is correlated to a high level of comprehension. Although no significant differences were found in AURA and PMS scores, anecdotal discussion and a post survey follow up with the experimental group found that communication between provider and patient was enhanced and the 3D digital scan was seen as a helpful visual aid in communicating severity of recession.

**Conclusion:** Statistical significance was difficult to achieve due to a small sample size and the high education level of participants. There were no significant findings regarding whether the use of a 3D digital scan as a visual aid, can improve patient communication self-efficacy and risk-literacy concerning periodontal disease. This pilot study did however show an increase in patient to provider communication concerning gingival recession.

**Purpose:** There is a range of clinical practices that dental professionals use to maintain implants, revealing a need for a more standardized approach. The purpose of this study was to determine the curricular content for dental hygiene programs in the United States (US) regarding implant maintenance. This research aimed to find out if the curricular content aligned with the CPG published by the ACP.

**Methods:** This descriptive research study utilized a survey to explore the implant maintenance curriculum in US dental hygiene programs. Descriptive statistics were used to examine the data.

**Results:** A total of 53 participants responded to the survey ( $n=53$ ). All of the programs (100%) felt that implant maintenance was important to include in the curriculum and 98.1% teach implant maintenance. This study helped identify the curricular content for implant maintenance: 94.3% teach preventative care techniques, 90.6% teach appropriate tools/materials, 92.5% teach patient education, 88.7% teach radiographic interpretation, and 83.0% teach recall frequency. This research has helped recognize where the curricular content aligns with the current CPG published by the ACP and that most programs are not utilizing the CPG as a resource for curricular development.

**Conclusions:** Dental hygiene programs are teaching dental implant maintenance but there is variety among the content and the resources used to develop that content. If more programs were to standardize their content, there could be less variety in treatment modalities in clinical settings for implant maintenance.