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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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Collaboration During a Global Health Crisis

Ann Battrell, MSDH

A major determinant of how organizations manage crises like the COVID-19 pandemic is the ability to collaborate. Organizations need to pull together experts with unique, cross-functional perspectives to solve rapidly changing, complex problems that have long-term implications to their associations and the professions they represent. The COVID-19 pandemic has had a significant impact on the delivery of oral health care services by dental hygienists and dentists. As a result, the American Dental Hygienists' Association (ADHA) and the American Dental Association (ADA), have demonstrated organizational agility and adaptability to support their respective professions in managing the crises. In order make sound decisions quickly (agility) and make recommendations for change (adaptability) the first step is to collect data from oral health care professionals. Ongoing research conducted during the COVID-19 pandemic has provided us with the important opportunity to learn not only about the COVID-19 virus itself, but how oral health care providers are being impacted by the pandemic and adapting to a much different professional environment.

The ADHA and the ADA Health Policy Institute (ADA HPI) have recently collaborated to study the prevalence of COVID-19 among dental hygienists in the United States, the infection prevention and control procedures and associated trends in mental health, and dental hygienists' employment patterns, as well as their attitudes toward working as dental hygienists during a pandemic. The ADHA – ADA collaborative research endeavor is the *first study* of the impact of the COVID-19 pandemic on dental hygienists in the United States (US). Important questions were asked regarding the availability of personal protective equipment (PPE), compliance with national guidance, avoidance of aerosol generating procedures, rates of anxiety, depression, and employment patterns impacting the overall dental hygiene workforce. Understanding the multifactorial effects of the COVID-19 pandemic on the dental hygiene community is essential for organizational responses and planning to support the dental hygiene community, in addition to workforce assessment and analysis.

There are so many lessons to be learned from this pandemic and we will surely continue to learn more over time. However, what I would say first, is that there is no single best or perfect response strategy to this pandemic. As the organization representing the interests of dental hygienists across the country, ADHA's response to the pandemic may need to change over time, but monitoring, learning, and adapting are key. Professional associations are being called upon to be stable in a very uncertain environment, but also to remain agile and adaptable as the further data becomes available. Adaptability in our current environment requires new forms of collaboration, shared decision-making, and accountability. The COVID-19 pandemic provided the ADHA and the ADA the unique and timely opportunity to collaborate through a research lens to assess the impact of the pandemic on our respective professions. As members of the oral health care team, dental hygienists and dentists are well-poised to demonstrate agility and adaptability through these uncertain times for better health outcomes for the public we serve.

We will continue to collect data in collaboration with the ADA HPI. We will also have the opportunity to share our ongoing findings through webinars co-sponsored by the ADHA and the ADA. It is clear that a wide range of response strategies to the COVID-19 pandemic will be needed as we move forward into year two. ADHA has made a commitment to knowledge-based decision making and this important research will enable us to stand by our commitment the oral health care professionals we represent and the public we serve.

The ADHA and ADA HPI research teams deserve special recognition and a great deal of appreciation for their important work. Together, we have created the two important manuscripts in this issue of the *Journal of Dental Hygiene.* JoAnn Gurenlian, led the ADHA efforts along with Cameron Estrich, Marko Vujicic, and Marcelo Araujo from the American Dental Association. I am continually humbled by their expertise and honored to have participated in this research collaboration. The dental hygienists who volunteered to be a part of this groundbreaking research in this unique time in history deserve the recognition and collective appreciation from their professional peers and ADHA. Without their input and sharing of their experiences, these studies would not be possible. Your commitment to the profession, and the public that we serve, particularly during these unprecedented times, makes me proud to serve you in my role as ADHA Chief Executive Officer.

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COVID-19 Prevalence and Related Practices among Dental Hygienists in the United States

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Abstract

Purpose: Throughout the COVID-19 pandemic, health care professionals have been challenged to provide appropriate preventive and therapeutic measures while using precautions to minimize disease transmission. The purpose of this study was to estimate the prevalence of COVID-19 among United States (US) dental hygienists, describe infection prevention and control procedures and any associated trends in mental health.

Methods: Registered dental hygienists (RDHs) licensed in the US were invited to participate in a 30-question web-based survey. COVID-19 infection items included probable and confirmed results, COVID-19 related symptoms experienced in the last month, and level of concern about COVID-19 transmission to patients and themselves. The validated Patient Health Questionnaire 4 screened respondents for depression or anxiety. Personal protective equipment (PPE) use when treating patients was assessed. The research protocol and survey were approved by the American Dental Association IRB and registered at clinicaltrials.gov (NCT04542915). Kruskal-Wallis and X^2 tests were used to test for associations between PPE use, PPE supply, mental health symptoms, and concern about COVID-19 transmission.

Results: As of October 8, 2020, a total of 4,776 dental hygienists from all 50 states and Puerto Rico participated in the study. Respondents reported elevated symptoms of anxiety and depression. Of the respondents, 3.1% (n=149) had ever tested positive or been diagnosed with COVID-19. The majority of respondents (99.1%; n=3,328) who practiced dental hygiene reported their primary dental practice had enhanced infection prevention or control efforts in response to the pandemic. PPE use was significantly associated with years of experience as a dental hygienist, level of concern about COVID-19, and level of PPE supplies available (p-values<0.01), but not type of dental practice (p-value 0.1).

Conclusion: As of October 2020, the estimated prevalence rate of dental hygienists in the US having had COVID-19 was low. There is a need for further support for dental hygienists' use of PPE and mental health.

Keywords: SARS-CoV-2, COVID-19, occupational health, infection control, personal protective equipment, dental hygienists

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Introduction

On February 11,2020, the *Coronaviridae* Study Group of the International Committee on Taxonomy of Viruses named the novel beta coronavirus as SARS-CoV-2.[1] This etiologic agent, or COVID-19 disease, has reached nearly every country worldwide in less than six months, resulting in significant morbidity and mortality. As of this article's publication date, there are over 63 million cases of COVID-19 globally, with over 1.4 million deaths, and over 17 million cases of COVID-19 in the United States (US) resulting in nearly 308,000 deaths.[2]

Infection and viral dissemination of SARS-Co-V-2 occurs through respiratory droplets from infected individuals while sneezing, coughing or talking without covering the mouth and nose.[3] The droplets may linger in the air and infect individuals who come into contact with them in an enclosed space.[4,5] Transmission is also possible through direct bodily contact with infected persons or contacting contaminated surfaces.[6]

Currently, there are limited therapeutic options for management of COVID-19. Supplemental oxygen and mechanical ventilation or extracorporeal membrane oxygenation for patients with refractory hypoxemia are used. Other therapies include convalescent plasma and immunoglobulin G, cortisone, and antiviral agents with limited success.[3,7] The development of several vaccines show promising results and are in active deployment. This accelerated development process for vaccines to prevent COVID-19 will necessitate further investigations concerning length of immunity, need for boosters, effects on high-risk populations, and equitable access.[8]

Throughout the pandemic essential workers have been challenged to provide appropriate preventive and treatment measures while using precautions to minimize disease transmission and risk. Due to close contact with patients, health care workers may be at increased risk of COVID-19 infection.[9] This risk may be heightened among oral health care workers, who may also be exposed to aerosolized infectious particles through aerosol-generating dental procedures such as scaling or polishing teeth with sonic or ultrasonic devices.[10] Alternately, dental professionals' customary use of personal protective equipment (PPE) and routine dental procedures, such as water irrigation and high-volume evacuation, may reduce infection risk.[11]

Dental professionals have been diagnosed with COVID-19,[12] but since community transmission is possible, and a retrospective study found no instances of dental-practice transmission of COVID-19 to staff or patients,[13] the level of occupational risk remains unresolved. A vital component of correctly balancing people's needs for oral health care, along with the occupational risk in providing such care, is an accurate assessment of the risk of COVID-19 transmission in dental practices. Unfortunately, data on COVID-19 among dental professionals in the US is limited. Most (84%) records available to the Centers of Disease Control and Prevention (CDC) are missing data on healthcare professions.[14]

A review of the literature related to COVID-19 infection control practices among dental professionals is limited, given the time frame of the initiation of this virus. Many of the studies have occurred in practice settings outside of the US. For example, one study examined the signs and symptoms, protective measures, awareness and perceptions levels of COVID-19 among dentists in Lombardy, Italy, during April 2020. A total of 9,247 survey invitations were emailed and 3,599 were completed for a response rate of 39.4%. Of the participants, almost 15% experienced one or more symptoms associated with COVID-19, most notably fever and fatigue. Thirty-one dentists tested positive for the virus and 16 individuals developed COVID-19 disease. Precautionary measures used most frequently included delaying patient appointments, so the waiting room was not crowded, increased ventilation of the waiting room, and operator handwashing before and after each procedure. Only two percent of participants were confident that they could avoid the infection.[15]

A report on a cross-sectional study of the knowledge and practice of dentists in Lebanon was conducted in April 2020. Using a sample size calculator, a sample size of 357 participants was sought among a total population of 5000 dentists; and 358 dentists completed the survey. Findings revealed the majority had good knowledge about COVID-19; however, deficits were noted related to coronavirus incubation periods, disease transmission, actions in dealing with positive cases, and precautionary measures. More than half of the respondents (60%) reported good practice while the remainder noted poor practices related to COVID-19. Over 80% of the respondents reported they were afraid to treat a patient suspected or confirmed as infected with COVID-19 and had concerns about becoming infected from a colleague. Nearly all respondents (96%) were afraid of the impact of this disease on their livelihood. The authors noted that these findings have implications for the development of strategies for improving practice and enhancing prevention programs.[16]

Dentists in Saudi Arabia were surveyed in May 2020 concerning questions about COVID-19, management in dental clinics, preventive measures in the reception area, and knowledge, practice and attitudes toward the pandemic. Of the 1,000 surveys sent, 287 responses were received for a response rate of 28.7%. Findings revealed good adherence to screening patients and adoption of preventive measures in the reception area. There was less agreement (46%) related to use of an isolation room for suspected COVID-19 patients. Similarly, most respondents reported that an airborne infection isolation room and extra-oral suction system did not exist in the dental clinic where they worked, and half reported their dental clinic did not offer proper management training sessions for their staff. Overall knowledge and attitude percentages were high. The authors noted that until a vaccine is developed, adhering to developed guidelines to prevent the transmission of the COVID-19 infection is imperative; yet one-third of the respondents had no work plan or were unaware of a work plan for patient screening and dental management in their practice setting. It was recommended dental clinics utilize additional educational sessions for their dentists and staff on the latest COVID-19 recommendations and closely monitor practitioners and staff to ensure adherence to guidelines.[17]

To date, only one national study of US dentists has been published. A web-based survey was conducted in June 2020 among dentists designed to determine the prevalence of COVID-19 and infection control practices of dentists in private practice or public health. Survey questions pertained to COVID-19 symptoms, SARS-CoV-2 infection, mental well-being, and infection control procedures used in practice. Most respondents (82.2%) had no COVID-19 related symptoms within the past month of survey administration; the most common symptom reported was headache. One-third experienced mild psychological distress. Prevalence and positive testing rates were low among the respondents with 16.6% being tested and 0.9% reporting confirmed or probable COVID-19 cases. Enhanced infection control practices were implemented among nearly all respondents (99.7%) and the majority of practices (72.8%) used PPE according to CDC interim guidance. The authors concluded that the use of the CDC interim guidance in dental practice settings will contribute to reduced risk of developing infection and noted that surveillance of US dentists will remain ongoing.[18]

While organizations have continued to issue training, guidelines, and toolkits related to practicing oral health care during the COVID-19 pandemic,[19,20] the actual infection prevention and control practices of dental hygienists have been not been reported on since May 2020.[21,22] One international study involved the impact of the pandemic on the dental hygiene profession from a global perspective. This study evaluated dental hygienists from 30 countries belonging to International Federation of Dental Hygienists and included 9,866 respondents (response rate not provided). Respondents indicated that guidance and PPE measures were being employed. Protective measures included screening patients for symptoms upon arrival (81%) and by phone when scheduling appointments (71%) and disinfecting all operatory surfaces after treatment (85%). Gloves, faces shields and surgical masks were being used by the majority of respondents. Nearly half reported wearing an N95 respirator, goggles, full gown and/or hair covering. However, concerns were expressed about PPE shortages (83%) and regarding patients delaying dental care (74%). Less than 2% had been diagnosed with COVID-19 and of those, fewer than 1% had symptoms.[21]

A cross-sectional survey of dental hygienists in Italy was performed during May 2020. This study used the same questionnaire that had been sent to dentists in Lombardy, Italy. Of 6,974 surveys sent, 2798 were entirely or partially completed, for a response rate of 40.12%. Findings revealed participants experienced symptoms of fatigue, headache and sore throat. Only 0.25% reported a positive diagnosis of COVID-19. Most frequent precautionary measures included telephone triage, spacing appointments, frequent ventilation and disinfection of the waiting room, and handwashing before and after procedures performed. Protective glasses or visor, disposable gloves and surgical mask were the PPE most frequently used. The authors concluded that respondents appeared to be prepared to manage the COVID-19 infection in the dental practice environment and seemed confident being able to avoid the infection while performing work-related activities.[22]

Presently, no studies have reported specifically regarding dental hygienists' COVID-19 practice experiences in the US. Therefore, a longitudinal survey was constructed to estimate the burden of COVID-19 among dental hygienists in the US, evaluate trends in mental health and professional practices, and identify COVID-19 risk factors for dental hygienists. The results from the first month's survey are reported here to describe COVID-19 prevalence, health, and COVID-19 related behaviors and practices among dental hygienists in the US.

Methods

A web-based survey was administered using Qualtrics (Qualtrics, Provo, UT) from September 29-October 8, 2020. All 133,000 registered dental hygienists who were in the American Dental Hygienists' Association's (ADHA) database received an invitation to participate on September 29, 2020; and a reminder invitation was emailed October 6, 2020. Individuals were eligible to participate in the survey if they were licensed as a dental hygienist in the US, were at least 18 years old, and were employed as a dental hygienist on March 1, 2020.

Potential participants read and signed an electronic informed consent before responding to the survey. The 30-question survey was constructed for this research and similar to the survey of US dentists.[18] Based on the first two months of identical questions among a panel of dentists, test-retest reliability was on average 85.4%. Demographic survey questions included birth year, race, ethnicity, gender, primary practice location, and years of experience as a dental hygienist. COVID-19 infection was ascertained by self-reported date, type, and positive result of a COVID-19 test (confirmed case) or, if not tested, the date a healthcare provider told the respondent they had COVID-19 (probable case). COVID-19 prevalence was estimated based on this information. Consistent with CDC surveillance, the positive test rate was defined by the numbers of confirmed cases over the total number of tested cases.[23] Respondents were also asked to identify symptoms experienced in the last month (defined as since August 29, 2020), health conditions associated with COVID-19 severity,[24] and dental and non-dental activities in the last month.

Since stressful events such as a pandemic may affect mental well-being, respondents were asked their level of concern about COVID-19 transmission to patients and to themselves on a 5 point scale (1 meaning "very concerned" and 5 meaning "not concerned at all), and the validated Patient Health Questionnaire 4 (PHQ-4) screened respondents for depression (using the PHQ-2 scale) or anxiety (using GAD-2).[25,26] Respondents who reported providing dental care in the last month were asked about infection prevention or control procedures in their primary dental practice. Respondents indicated which PPE they used when treating patients in the past month, and whether they used it sometimes, or always. The CDC interim guidance document was used to categorize PPE use,[19] such that respondents were categorized as following PPE guidance for aerosol-generating procedures, if in addition to basic clinical PPE of gloves and protective clothing, they wore an N95 or similarly protective respirator (also called N95 mask) with eye protection. Dental hygienists who performed no aerosol-generating procedures in the past month were categorized as following PPE guidance if they wore gloves, protective clothing, a surgical mask (or a mask or respirator that offers an even higher level of protection) and eye protection. Finally, respondents who reported wearing respirators or masks were asked how often they were changed. The research protocol and survey were approved by the American Dental Association Institutional Review Board and registered at clinicaltrials.gov (NCT04542915).

Proportions, frequencies, and means were calculated in Stata 13.0 (StataCorp LP, Texas). For categorical variables, differences were tested using X^2 tests, and with Kruskal-Wallis tests for non-normal continuous variables, with statistical significance set at 0.05. Due to complex survey design skip patterns, and because respondents were able to skip any question or stop answering the survey at any time, not all respondents answered all questions; the percent missing ranged from <1 to 9% per question. Since respondents' behaviors, health, and concern may be related to the level of COVID-19 risk in their area, the average incidence rate of COVID-19 in their state or territory, for the days included in the survey (August 29-October 8, 2020), was calculated using data made publicly available by Johns Hopkins University.[27]

Results

Of the dental hygienists identified in the ADHA database, 4,804 volunteered to participate in this research study. Of these individuals, a total of 4,776 dental hygienists originating from all 50 states and Puerto Rico participated in the web-based survey from September 29-October 8, 2020 for a completion rate of 99.4%. Respondents were aged 18 to 77 years (mean: 44.1, standard deviation: 12.0). The majority were non-Hispanic White (72.5%, n=4,066), female (98.1%,n=4,034), and primarily worked in a private solo dental practice (52.5%, n=2,161). Of the total sample, 31.9% (n=1,523) had at least one medical condition associated with a higher risk of developing severe illness from SARS-CoV-2.[24] Respondents had varying levels of experience, but the majority (64.4%, n=2,655) had been a practicing, licensed dental hygienist for 11 years or more. Demographic information is summarized in Table I. Dental hygienists were asked regarding their experiences of symptoms associated with COVID-19, even if they thought the symptoms were not due to COVID-19. Respondents could report multiple symptoms. The most common physical symptoms experienced in the past month were headaches (32.2%, n=1,547), congestion (24.8%, n=1,189), or fatigue (17.3%, n=829) (Table II). Respondents also answered the Patient Health Questionnaire-4, which evaluates symptoms of anxiety and depression. In the two weeks before taking the survey, 25.7% (n=1,077) of the respondents experienced elevated symptoms of anxiety (GAD-2 mean:1.73, standard deviation: 1.84) and 16.05% (n=673) experienced elevated symptoms of depression (PHQ-2 mean:1.21, standard deviation:1.59). Symptoms of anxiety and depression were significantly associated with age, with the highest levels of symptoms among those aged 18-29 years and the lowest levels among those aged 64 years or older (Kruskal-Wallis p-values <0.01).

Dental hygienists were surveyed regarding activities outside of their home in the past month (Table II). Of those responding, 18.8% (n=896) reported no contact with those outside of their household. Less than a third (32.4%; n=1,548) reported interacting with a group of ten or more people, while 12.8% (n=610) had attended a large public event in the past month. Only 9.1% (n=436) of dental hygienists reported they had in-person contact with someone with suspected or confirmed COVID-19 in the past month.

In the month preceding the survey, 70.3% (n=3,357) responding dental hygienists had provided dental care to patients as summarized in Table III. For the majority of respondents (90.7%; n=3,037), this care included dental procedures likely to generate aerosols. Among those who practiced dentistry that month, 99.1% (n=3,328) reported at least one enhanced infection prevention or control effort in their primary dental practice. The most common methods were disinfection between patients (97.9%, n=3,287), staff masking (97.8%, n=3,284), and screening patients prior to dental treatment (96.7%, n=3,247) (Table III). Most respondents (96.8%, n=3,249) reported that their primary

Table I. Sample demographics (n=4776)

Characteristic	%	n
Age group (years)		
18-29	12.5	500
30-39	28.2	1133
40-49	23.9	961
50-64	31.2	1254
65-77	4.2	169
Race/ethnicity		
Non-Hispanic White	72.5	4066
Hispanic/Latino	5.9	331
Non-Hispanic Asian	2.8	154
Non-Hispanic Black	1.8	100
American Indian/Alaska Native	0.6	34
Native Hawaiian/Pacific Islander	0.2	9
Other	16.3	916
Gender		
Male	1.0	42
Female	98.1	4034
Other or prefer not to say	1.0	40
Dental practice type		
Private solo practice	52.5	2161
Other dental practice	38.4	1581
Public health clinic/Community health center/Federally Qualified Health Center/ Tribal health center	4.5	185
Academic/university/college	2.8	115
School-based setting	1.0	40
Military	0.5	19
Other	0.3	14

Characteristic	%	n
Experience as a dental hygienist (years)		
0-10	35.6	1468
11-20	27.6	1136
21 or more	36.8	1519
US Census Bureau division		
New England	9.0	341
Middle Atlantic	11.5	439
East North Central	16.2	616
West North Central	7.3	276
South Atlantic	17.2	654
East South Central	5.0	190
West South Central	7.2	274
Mountain	10.4	397
Pacific	16.3	621
Territories	0.03	1
Conditions (multiple conditions per person allowed)		
Asthma	9.5	455
Chronic lung disease	0.5	23
Diabetes	2.2	106
Heart condition	3.0	96
Immunocompromised	2.9	140
Kidney disease	0.4	17
Liver disease	0.3	12
Obesity	8.4	402
Rheumatologic or autoimmune condition	5.3	255
Smoking	1.8	85
Other	9.0	432

dental practice had at least five different infection control practices in place. A minority of respondents also reported their primary dental practice asked staff (2.3%, n=78), patients (28.8%, n=968), or both (12.0%, n=401) to sign a waiver related to COVID-19 (Table III).

At the time of the survey, CDC interim guidelines for PPE included wearing eye protection in addition to a mask during all patient care encounters, and using an N95 respirator or equivalent during dental procedures likely to generate aerosols.[19] Among the respondents who provided oral health care that month, 28.2% (n=945) reported not following the CDC interim guidelines for PPE for patient care (Table III). Dental practice type was not statistically significantly associated with whether hygienists used PPE according to CDC guidelines (X^2 p-value=0.1) (Table IV). However, years of experience as a dental hygienist was significantly associated with always following CDC PPE guidelines. Over half, (54.6%, n=659) of those with 10 or less years of experience always used PPE according to guidelines, compared with 55.4% (n=511) of those with 11-20 years, and 60.7% (n=692) of those with 21 or more years of experience (X^2 p-value<0.01) (Table IV). Respondents expressing the highest levels of concern regarding COVID-19 transmission to themselves or patients were more likely to always use PPE according to CDC guidelines (Kruskal-Wallis tests p-values <0.01). The incidence of COVID-19 in their state during the study period was not statistically significantly associated with whether dental hygienists always wore PPE according to CDC guidelines (Kruskal-Wallis test p-value=0.4).

Table II. Recently reported symptoms and activities (n=4776)

	%	n
Physical symptoms in the last month		
Chills	3.1	147
Congestion or runny nose	24.8	1189
Diarrhea	11.2	536
Dry cough	8.9	427
Fever	1.8	84
Headache	32.2	1547
Muscle pain or body aches	16.7	800
Nausea or vomiting	5.1	244
New loss of taste or smell	1.6	79
Repeated shaking with chills	0.5	25
Sore throat	13.5	647
Shortness of breath or difficulty breathing	5.1	245
Fatigue/malaise	17.3	829
Other	2.9	141
Mental health in last two weeks		
Likely anxiety (GAD-2 ≥3)	25.7	1077
Likely depression (PHQ-2 ≥3)	16.0	673
Activities in the past month		
Provided emergency dental care	11.8	564
Provided elective dental care	69.8	3334
Attended a health care visit for myself or a companion	47.3	2259
Met in person with anyone outside your household	76.4	3650
Met with a group of 10 or more people in a social setting	32.4	1548
Attended any public event with 50 or more people	12.8	610
Traveled by taxi, ride share, or public transportation	8.1	388
Met in-person with anyone with suspected or confirmed COVID-19:	9.1	436
Member of household	1.3	63
Coworker	3.5	168
Dental patient	2.8	135
Someone else	2.9	139

Dental hygienist use of N95 respirators was statistically significantly associated with the number of days' supply of N95 respirators, or their equivalent, in their primary place of employment. Only 1.3% of respondents always used N95s during patient care if their practice had 0 days' supply. However, this percentage increased with increasing supply, such that 14.2% always used N95s if they had 8-14 days' supply, and 61.9% always used N95s if their practice had more than 14 days' supply (X^2 p-value<0.01). Since CDC interim guidance includes the use of a N95, or equivalents, during aerosol-generating dental procedures, it naturally followed that practice level of supplies of N95 or equivalent respirators was also significantly associated with respondent's use of PPE according to CDC guidelines (Table IV). Respondents most commonly reported changing their mask or respirator between each patient (42.3%, n=1157); the remainder changed it less often. Respondents who had more than 14 days of surgical masks or N95 or equivalent respirators were most likely to change their mask or respirator between every patient (X^2 p-values <0.01).

Dental hygienists were asked if they had ever been tested or diagnosed with COVID-19. Approximately one-third (35.4%, n=1,691) had been tested for SARS-CoV-2 at least once. The most common testing method utilized nasal or throat swabs (33.1%, n=1,583), with a 7.8% positive test rate (n=123). Only 5.4% (n=260) were tested using blood samples, with an 8.5% positive test rate (n=22). The least common testing method used were saliva samples, reported by 1.4% of respondents (n=65), with a 4.6% (n=3) positive test rate. Twenty-three (0.5%) dental hygienists surveyed were not able to be tested but were diagnosed with COVID-19 by a physician. In total, 3.1% (n=149) of the respondents had ever had COVID-19 by October 8th, 2020 (Table V). About one third of the dental hygienists with COVID-19 (37.8%, n=55) reported that contact tracing for the likely source of their COVID-19 infection was performed. For 25.5% (n=14) of those traced, contact tracing identified the respondent's primary place of work as the likely source of transmission.

Not all respondents remembered the date for which they sought testing or medical care for COVID-19, however, 10.3% (n=492) reported being tested or diagnosed since September 1, 2020. In total, 0.8% (n=39) of the respondents were diagnosed with COVID-19 or tested positive between September 1, 2020 and October 8, 2020, while 9.5% (n=453) tested negative for COVID-19. Among those tested or diagnosed in the past month, a significantly higher proportion of those

Table III. Reported infection prevention and control efforts in dental practices (n=3357)*

	Reporting (%)	n
Infection prevention and control efforts in the past month		
Screen or interview patients for known or suspected COVID-19 infection before dental appointment or treatment	94.0	3157
Check patient temperatures with a thermometer before dental treatment	96.7	3247
Check dental hygienist's temperature with a thermometer at the beginning of their shift	86.5	2904
Disinfect frequently touched surfaces and materials such as pens or light switches	91.4	3069
Disinfect all equipment in the operatory between patients	97.9	3287
Encourage distance between patients, such as scheduling appointments farther apart, asking patients to wait elsewhere, or asking patients not to bring companions	85.7	2876
Physical protection in the practice, such as erecting barriers, opening windows, or using air filters or scrubbers	75.0	2516
Provide face masks or coverings to staff	97.8	3284
Provide face masks or coverings to patients	71.6	2404
Teledentistry	14.8	497
Other	7.5	250
COVID-19 related waiver		
Dental practice asks staff or patients to sign a waiver	43.1	1447
No waiver	55.3	1857
Unknown	1.6	53
Personal Protective Equipment while treating patients in the past month		
Did not report using PPE according to current CDC interim guidelines	28.2	945
Sometimes used PPE according to current CDC interim guidelines	16.1	541
Always used PPE according to current CDC interim guidelines	55.7	1871

* Limited to respondents who performed dental procedures in the past month

with symptoms (11.6%, n=36) had COVID-19 than without (1.7%, n=3) (p-value<0.01). There was no statistical difference in COVID-19 positive tests in the past month among those who practiced (1.9%, n=48) or did not practice dental hygiene (1.1%, n=14) in the past month (X^2 p-value= 0.09). There was also no statistical difference in COVID-19 incidence rate in their state or territory between those who tested positive or negative since September 1, 2020 (Kruskal-Wallis p-value = 0.9).

Discussion

This study is one of the only descriptions of COVID-19 prevalence, infection control practices or PPE use among dental hygienists in the US during the COVID-19 pandemic. Dental hygienists' rates of enhanced infection control procedures in dental practices are similar to the rates reported by US dentists[18] and higher than those found in international surveys of dental hygienists.[21,22]

Similar to other surveys of dental hygienists practicing during the pandemic,[21,22] not all dental hygienists participating in the present study reported wearing N95 or equivalent respirators. As was found in a study among Italian dental hygienists,[22] years of experience, but not community level of COVID-19 infections, are associated with PPE use. As intuitively makes sense, in the current study, dental hygienists' use of N95 or equivalent respirators was associated with respirator availability at their workplace. Increasing dental practices' supplies of N95, or equivalent respirators, may enhance PPE use. Alternatively, if dental practices followed national guidance and avoided aerosol generating procedures whenever possible, the limited supply and use of N95 or equivalent respirators by dental professionals would not be as problematic.[19,20]

The issue of national guidance to protect dental health care personnel and patients from infection is an important consideration. This study revealed that slightly more than half of the respondents (55.7%) always used PPE according to current CDC interim guidance. Consistent adherence to PPE guidance was highest among those who were most concerned about COVID-19, had more years of experience as a dental hygienist, or had higher supplies of N95 or their equivalent. A global study of dental hygienists indicated that almost half of respondents were wearing an N95 respirator, goggles, full gown and/or hair covering, but the majority (92%) indicated that they would have to wear more PPE in the future. They were also

Table IV. Factors associated with adherence to CDC Interim Guidelines for PPE (n=3357)*

Characteristic	Always used PPE according to CDC interim guidelines (%)	n	X^2 *p*-value
Dental practice type			
Private solo practice	54.5	952	
Other dental practice	56.2	731	
Public health clinic/Community health center/Federally Qualified Health Center/Tribal health center	62.0	85	0.1
Academic/university/college	70.4	50	
School-based setting	50.0	9	
Military	53.9	7	
Other	55.6	5	
Experience as a dental hygienist (years)			
0-10	54.6	659	<0.01
11-20	55.4	511	
21 or more	60.7	692	
N95 or equivalent masks or respirators supply			
Not sure	52.5	253	
0 days	13.6	29	
1-7 days	46.4	185	<0.01
8-14 days	58.3	266	
More than 14 days	63.8	1112	

* Limited to respondents who had performed dental procedures in the past month

Table V. Probable and confirmed COVID-19 infection (n=4776)*

Tested for COVID-19	Tested (%)	n	Positive test (%)	n
Nasal or throat swab (tests for current SARS-CoV-2 virus)	33.1	1583	7.8	123
Blood sample (tests for past SARS-CoV-2)	5.4	260	8.5	22
Saliva sample (tests for current SARS-CoV-2 antigen)	1.4	65	4.6	3
Not tested, but diagnosed by healthcare provider	NA**	NA	0.5	23
Total ever tested positive or had positive diagnosis	3.1	149	NA	NA

*Multiple types of testing may have been performed

** not applicable

concerned (>80%) that there would not be an adequate supply of PPE to treat patients.[21] A study of Italian dental hygienists revealed a higher level of adherence to national and international guidelines for use of PPE , but less so with other precautionary measures.[22] Further study is needed to identify other factors that may be associated with strict adherence to guidelines including awareness of current guidelines, philosophy of dental practice, availability of other PPE, and financial issues.

The Joint American College of Academic International Medicine-World Academic Council of Emergency Medicine Working Group on COVID-19 caution that significant rates of anxiety, depression, and other mental health disorders among the general health population, as well as health care providers, are to be expected, including suicidal ideation and suicide. The proportion of dental hygienists experiencing anxiety in the present study (25.7%) is similar to anxiety levels found among the general US population (25.5%), during the COVID-19 pandemic; however respondents had lower levels of depression (16,0%) as compared to the general population (24.3%).[28] In comparison, dentists in the US reported lower rates of anxiety (14.8%) and depression (8.9%) than the dental hygienists;[18] however, nurses in Michigan reported significantly higher rates of anxiety (54.95%) and depression (59.5%)[29] than either dentists or dental hygienists. A study of dentists and dental hygienists in Israel revealed a low rate of elevated psychological distress, found (11.5%) experiencing distress, most notably associated with those who had background illness, fear of contracting COVID-19 from a patient, and higher subjective overload.[30] These differences in mental health symptoms by profession may reflect longer periods of contact with potentially infectious patients, may be related to levels of perceived control in the workplace, age differences, or other

factors, and warrant further investigation. These findings underscore the importance of mental health resources needed to help individuals cope with the emotional stress of the pandemic.[31]

As of October 8, 2020, an estimated 3.1% of dental hygienists in the US have had COVID-19. In the general US population on the same date, an estimated 2.3% or 7.6 million people have had COVID19.[2] Both of these cumulative prevalence rates are lower than has been found in non-dental, health care workers in the US.[32] The two international studies focusing on dental hygienists also reported prevalence rates of less than 2%.[21,22] The low rate reported in the present study may reflect the safety measures taken by dental hygienists to protect their patients and dental team members.

There are limitations to these findings. This study is based on self-reported data, which may be subject to recall or social desirability bias. COVID-19 testing is limited and is primarily available to those with symptoms or contact with someone who has already tested positive for COVID-19, so, as with surveillance in the general US population,[23] less severe, or asymptomatic cases of COVID-19, may be missed. Severe cases of COVID-19 resulting in hospitalization or death would also be underestimated by this study. There was insufficient statistical power to test for differences in recent COVID-19 infection by dental-practice-related factors, such as PPE use or infection control practices.

Future research, using data from this ongoing longitudinal study, may be able to evaluate these factors and will continue to examine prevalence of COVID-19 among dental hygienists in the US, risk factors for COVID-19, use of PPE in dental practice settings, employment factors, and mental health status. Further study is needed to identify other factors that may be associated with COVID-19 infection including awareness of, and strict adherence to guidance, philosophy of dental practice, availability of other PPE, and financial issues.

Conclusion

As of October 2020, the prevalence of ever having had COVID-19 was estimated to be 3.1% among dental hygienists in the US. Enhanced infection control efforts were reported in 99.1% of dental practices. Not all dental hygienists reported using PPE during dental procedures according to CDC interim guidelines; this finding may improve with increased access to PPE. Ongoing data collection among this sample,will enable estimation of the incidence rate of COVID-19 among US dental hygienists and identifying dental practice-related risk factors for SARS-CoV-2 infection.

Disclosure

The authors have no conflicts of interest to report.

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Employment Patterns of Dental Hygienists in the United States During the COVID-19 Pandemic

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Abstract

Purpose: The COVID-19 pandemic has led to drops in patient volume and staffing in dental practices in the United States (US). This study aimed to provide insights on dental hygienists' employment patterns as well as their attitudes toward working as dental hygienists during a pandemic.

Methods: Licensed dental hygienists were invited to participate in a web-based 30-question survey between September 29 and October 8, 2020. Employment questions included current and pre-pandemic work status, reasons for not currently working as a dental hygienist, and estimated levels of personal protective equipment (PPE) in the primary work location. All statistical analysis was conducted in Qualtrics Core XM; cross tabulation was used to examine dental hygienist working patterns and attitudes by age, practice PPE supply, and other factors.

Results: The COVID-19 pandemic has led to an estimated 8% reduction in dental hygienist employment. The majority (59.1%, n=205) of this reduction is voluntary, with the main reason being general concerns over COVID-19 (48.3%, n=100). Other reasons include issues surrounding childcare and concerns over safety measures in the workplace. Dental hygienists aged 65 and older were most likely to have left the workforce voluntarily. More than half of respondents reported that their work locations had more than a two-week supply of most PPE items, although about 10% did not know supply levels. Dental hygienists working in settings with lower supplies of PPE were more concerned with COVID-19 transmission risk to themselves or to patients.

Conclusion: COVID-19 has led to a reduction in the dental hygienist workforce that is likely to persist until the pandemic passes.The dental hygienist labor market has tightened and employers may continue to experience difficulties in filling vacant dental hygienist positions until the pandemic subsides. There is also likely to be a longer term, yet smaller, impact on dental hygiene employment levels.

Keywords: COVID-19, employment patterns, dental hygienists, pandemic, dental hygiene workforce

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Introduction

The COVID-19 pandemic is having a major effect on the dental care delivery system in the United States (US). Patient volume in dental offices fell to about 7% of typical levels during the period when dental offices were closed. Subsequently, it has rebounded, but not completely. The latest data, in fact, suggest that dental patient volume will remain at about 80% of pre-COVID-19 levels, at least until a vaccine or proven treatment is available.[1] Employment in dental care settings, including private practices, dropped by more than half during the period of the dental care shutdown from March to May 2020 and has since stabilized at about 98% of pre-COVID-19 levels, as of October 2020.[2] The decline and subsequent rebound in patient volume in the dental care sector stemming from the pandemic is unprecedented in the history of dentistry as well as compared to other sectors of health care. Occupations in dentistry were identified early in

the pandemic as occupations with higher-than-average risk for infection.[3] In fact, dental hygiene itself was identified as one of the most at-risk non-hospital occupations during a pandemic, with a rating of 99.7 of 100 due to contact with others, physical proximity with others, and exposure to disease and infection.[3]

The pandemic has had a significant effect on the United States (US) labor market, particularly among women. A variety of factors, including school and daycare closures, the unequal burden of caring for aging parents, and risk of infection being higher in female-dominated occupations, have caused a major exit of women from the labor force in general. These effects could be long lasting, persisting even after the pandemic comes under control.[4] Dental hygiene has been well documented as a female-dominated profession, with men making up only 4% of the workforce.[5]

Little is known about the employment patterns of dental hygienists since the pandemic began. A recent study conducted by the International Federation of Dental Hygienists (IFDH) from May 5 to May 31, 2020, examined over 9,800 dental hygienists from 30 member countries. At that time, results indicated that 52% of the respondents were not working at all due to COVID-19, while 41% were providing some form of in-office clinical care. Further, 50% either agreed or strongly agreed that they were concerned about being unemployed. In the IFDH study, 20% were neutral on employment issues and 30% either disagreed or strongly disagreed regarding concerns related to unemployment.[6] No other information about employment patterns were addressed.[6] Dental hygienists in Italy completed an online survey during May 2020 to ascertain personal data, protective measures, awareness and risk perception related to COVID-19. The only reference to employment patterns noted in the study was that 63.13% of the respondents stopped working for at least three weeks when the pandemic began in February 2020.[7]

In comparison, since the onset of the COVID-19 pandemic, there have been regular analyses of its impact on dentists. In late March, the American Dental Association (ADA) Health Policy Institute (HPI) began tracking thousands of dentists and regularly reported on their employment and practice status, their patient volume, and their staffing levels.[8] These ongoing analyses have been invaluable in providing a data-driven, empirical snapshot of how the pandemic is affecting dentists in the US. Beginning in September 2020, the American Dental Hygienists' Association (ADHA) partnered with HPI to begin tracking similar data for dental hygienists. One study, a companion paper to this work, reported estimates of the prevalence of COVID-19 among US dental hygienists, infection prevention and control procedures, and associated trends in mental health. In this paper, the impact of the COVID-19 pandemic on the labor market for dental hygienists is examined. The purpose of this study was to investigate how the COVID 19 pandemic has affected employment patterns of US dental hygienists and their attitudes toward the perceived risks associated with working as a dental hygienist.

Methods

An anonymous web-based survey was administered using Qualtrics (Qualtrics, Provo, UT) from September 29 to October 8, 2020. Licensed dental hygienists based in the US were invited to participate in the study if they were age 18 years or older and employed as a dental hygienist as of March 1, 2020. A total of 133,000 dental hygienists, who were subscribed to the ADHA email listserv, were invited to participate in the survey. Of this group, 4,804 dental hygienists volunteered to participate. The survey was sent on September 29, 2020, and a reminder email was sent on October 6, 2020. The research protocol and survey were approved by the ADA Institutional Review Board and registered at clinicaltrials.gov (NCT04542915).

Potential participants read and signed an electronic informed consent document before responding to the study. A 30-question survey was constructed for this study and was similar to the survey of US dentists.[9] In the original survey, the test-retest reliability was on average 85.4%, based on the first two months of identical questions among a panel of dentists.[9] Demographic survey questions included age, race/ethnicity, gender, primary practice location, and years of experience as a licensed dental hygienist. Employment questions included current and pre-pandemic work status, reasons for not currently working as a dental hygienist, and estimated levels of personal protective equipment (PPE) in the primary work location. Level of concern about COVID-19 transmission to patients and to themselves in the workplace was assessed using a 5-point scale (1 = very concerned; 5 = not concerned at all). Items related to COVID-19 infection were also included in the survey and were analyzed in a separate paper.

All statistical analysis was conducted in Qualtrics Core XM. Descriptive characteristics were used to describe dental hygienists' employment status, PPE levels, and concerns regarding COVID-19 transmission to patients and self. Cross tabulation analysis included reasons for not working by age group, level of concern for patients and self by the supply of N95/KN95 masks in primary work location, pre-pandemic

and current employment status by age group, and employment status by primary work location type. Differences between non-normal continuous variables were tested using Kruskal-Wallis tests and between categorical variables with X^2 tests, with statistical significance set at 0.05 and were conducted in Stata 13.0 (StataCorp LP, TX, USA). Text analysis was performed on two open-ended responses for dental hygienists with other reasons for not currently working in the profession.

Due to complex survey question skip patterns and because respondents were able to skip any non-screening question or stop answering the survey at any time, not all respondents answered all questions. The missing response rate ranged from <1% to 9% per question.

Results

Of the 4,804 dental hygienists who originally volunteered to participate in the survey, 4,776 respondents from all 50 states and Puerto Rico agreed to the informed consent and completed the survey for a completion rate of 99.4%. Respondents were female (98.1%, n=4,034), 18 to 77 years of age (mean: 44.1, standard deviation: 12.0) and predominantly non-Hispanic White (72.5%, n=4,066). Almost one-third of the sample (31.9%, n=1,523) had at least one medical condition associated with a higher risk of developing severe illness from SARS-CoV-2.[10] The majority of respondents were employed in a private solo practice (52.5%, n=2,161) or other dental practice (38.4%, n=1,581) while a small percentage of respondents were employed in public health settings (4.5%, n=185), academia (2.8%, n=115) or other areas (1.8%, n=73); 70.3% (n=3,357) of the responding dental hygienists had provided dental care to patients in the month before the survey. Table I highlights the demographic information.

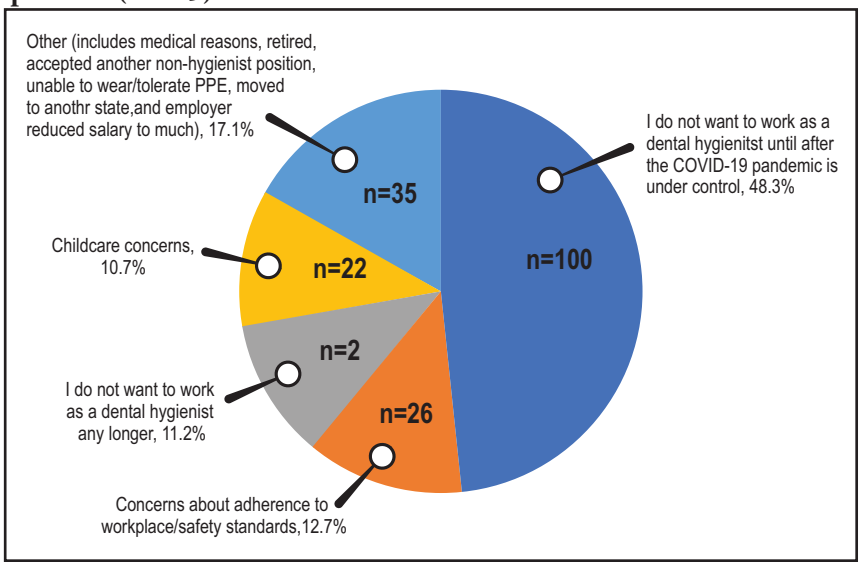
Dental hygienists participating in the survey were asked their employment status on March 1, 2020 (before the closure of dental practices in the US due to the COVID-19 pandemic) and their current employment status at the time of the survey, which corresponded to the first week of October. A decrease was found in the percentage of dental hygienists employed full-time from March 1 (65.7%; n=3,072) and at the time of the survey (59.0%; n=2,679). Among the respondents employed part-time, this percentage remained constant, standing at 30.4% (n=1,423) on March 1 and 31.1% (n=1,414) at the time of the survey (Table II).

Changes in employment status pre- and post-COVID differed by age group, with older dental hygienists affected more significantly. Among dental hygienists age 65 and older, the percentage employed full-time decreased by 11.2 percentage points compared to 6.2 percentage points among dental hygienists under age 35 (X^2 p value: 0.001). Nearly one-quarter of respondents over age 65 (n=41) reported they are not currently employed as a dental hygienist compared to 5.8% of the respondents under age 35 (n=60) (Table II).

Among the respondents currently employed in the workforce, three in five (n=2,484) reported they are working the same number of hours as they were before the pandemic began, whereas one-fifth (n=899) reported working reduced hours. For those respondents working in solo dental practices, nearly one-quarter (n=489) reported working reduced hours, compared to 11.9% (n=19) of respondents working in dental service organizations (DSOs), 19.0% (n=216) in group dental practices, and 16.4% (n=29) in public health clinics or federally qualified health centers. In fact, one-fifth of the respondents employed in DSOs (n=32) reported working more hours than before the COVID-19 pandemic.

Nearly one in twelve respondents (7.9%; n=360) who were employed as dental hygienists on March 1 reported they have since left the workforce. Within this group, 59.1% (n=205) reported leaving their dental hygienist position voluntarily while 24.1% (n=84) were laid off/furloughed and 16.7% (n=58) were permanently let go. There were also important differences by age, though not statistically significant (X^2 *p*-value: 0.3). Respondents over age 65 were more likely to report having voluntarily left their positions (68.3%; n=28) compared to respondents under age 35 (53.3%; n=32). Over one-quarter of respondents age 45-54 reported that they were permanently let go from their positions.

Figure 1. Reasons cited for voluntarily leaving a dental hygiene position (n=205)



Among the respondents who voluntarily left their positions, the most common reason given was not wanting to return to work until the COVID-19 pandemic is under control (48.3%; n=100). Other reasons included concerns about adherence to workplace/safety standards at their place of employment (12.7%; n=26), no longer wanting to work as a dental hygienist (11.2%; n=23), and childcare concerns (10.7%; n=22) (Figure 1).

Among respondents who were let go from their positions, 35.9% (n=51) reported that they have not returned to work because they preferred to wait until the COVID-19 pandemic is under control. Equal numbers of respondents (11.3%; n=16) reported they have not yet found another position or are waiting to be rehired by their original practice setting.

Some respondents who have become unemployed since March 1 (whether voluntarily or not), cited concerns over the ongoing pandemic and anxiety about workplace safety as reasons for not currently practicing dental hygiene. Respondents who are currently still employed were also asked questions regarding their safety concerns. On a scale of 1 to 5 (1=Very concerned; 5=Not concerned at all), respondents rated their overall concerns regarding the risk of transmission to patients as 3.26 and to themselves as 3.15 (Figure 2). Concerns varied relative to the PPE supply in their primary

Table I. Sample demographics (n=4776)

Characteristic	%	n
Age group (years)		
18-29	12.5	500
30-39	28.2	1133
40-49	23.9	961
50-64	31.2	1254
65-77	4.2	169
Race/ethnicity		
Non-Hispanic White	72.5	4066
Hispanic/Latino	5.9	331
Non-Hispanic Asian	2.8	154
Non-Hispanic Black	1.8	100
American Indian/Alaska Native	0.6	34
Native Hawaiian/Pacific Islander	0.2	9
Other	16.3	916
Gender		
Male	1.0	42
Female	98.1	4034
Other or prefer not to say	1.0	40
Dental practice type		
Private solo practice	52.5	2161
Other dental practice	38.4	1581
Public health clinic/Community health center/Federally Qualified Health Center/ Tribal health center	4.5	185
Academic/university/college	2.8	115
School-based setting	1.0	40
Military	0.5	19
Other	0.3	14

Characteristic	%	n
Experience as a dental hygienist (years)		
0-10	35.6	1468
11-20	27.6	1136
21 or more	36.8	1519
US Census Bureau division		
New England	9.0	341
Middle Atlantic	11.5	439
East North Central	16.2	616
West North Central	7.3	276
South Atlantic	17.2	654
East South Central	5.0	190
West South Central	7.2	274
Mountain	10.4	397
Pacific	16.3	621
Territories	0.03	1
Conditions (multiple conditions per person allowed)		
Asthma	9.5	455
Chronic lung disease	0.5	23
Diabetes	2.2	106
Heart condition	3.0	96
Immunocompromised	2.9	140
Kidney disease	0.4	17
Liver disease	0.3	12
Obesity	8.4	402
Rheumatologic or autoimmune condition	5.3	255
Smoking	1.8	85
Other	9.0	432

Table II. Employment status among respondents pre-COVID-19 (n=4674) and currently (n=4543)

	Status on March 1, 2020						Current Status							
Years of Age	Employed Full-Time		Employed Part-Time		Semi-Retired		Employed Full-Time		Employed Part-Time		Semi-Retired		Not Employed	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Under 35	74.4	775	25.4	264	0.2	2	68.2	710	25.7	268	0.3	3	5.8	60
35-44	71.3	798	28.7	321	0.1	1	61.3	686	31.3	351	0.4	4	7.1	79
45-54	67.0	599	32.4	290	0.6	5	58.4	522	32.7	292	1.2	11	7.7	69
55-64	59.1	469	38.2	303	2.8	22	51.3	407	35.4	281	4.0	32	9.3	74
65+	39.6	67	51.5	87	8.9	15	28.4	48	39.6	67	7.7	13	24.3	41
All Ages	65.7	3,072	30.4	1,423	1.2	56	59.0	2,679	31.1	1,414	2.0	90	7.9	360

Figure 2. Level of concern regarding risk of COVID-19 transmission in primary work location

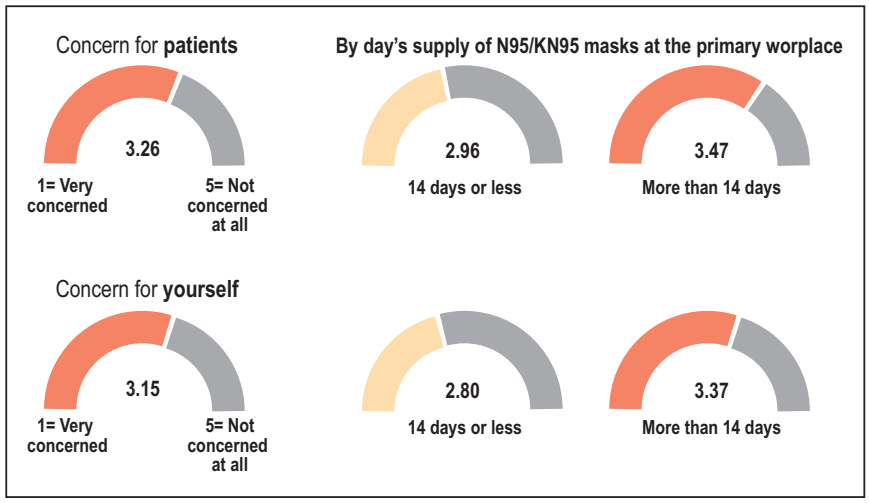
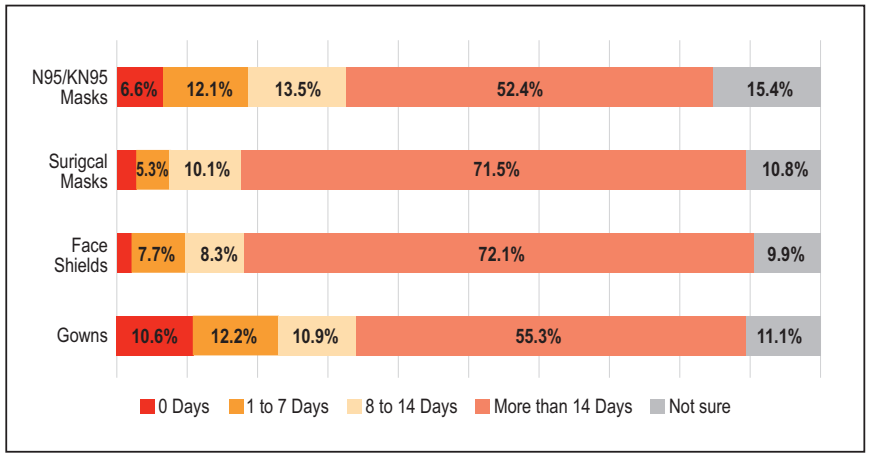


Figure 3. PPE supplies at primary work locationtion



practice location. Respondents whose practices had two weeks' worth of N95/KN95 masks or less, were more concerned than respondents whose practices had more than two weeks' worth of N95/KN95 masks (Kruskal-Wallis *p*-values <0.001). When examined by age, the level of concern to both patients (3.09) and themselves (2.97) was greatest among respondents age 65 and older; however, the difference was not statistically significant (Kruskal-Wallis *p*-values>0.1). For all other age groups, there was little variation. It should be noted that for each category of PPE supplies respondents were asked about, about one in ten reported not knowing how many days of supplies their primary work location had. At least half of the respondents (52.4%, n=2,082) reported that their primary work location had more than 14 days of supplies for each PPE category. Nearly seven percent (n=264) of respondents reported that their primary work location did not have any N95/KN95 masks (Figure 3).

Of 329 respondents who have become unemployed since March 1, more than half reported either receiving unemployment benefits (n=143) or that they have applied for benefits but have not yet received any (n=20). Another 38.3% (n=126) had not applied for unemployment benefits. Over one in ten (12.2%; n=40) reported that their unemployment benefits applications had been denied.

Discussion:

COVID-19 is bringing unprecedented disruption to the US health care sector, including the health workforce. This is the first research to date that explores these issues based on robust, nationally representative data. Analysis of this study indicates that 7.9% of dental hygienists have exited the workforce since the onset of the COVID-19 pandemic. This translates to an estimated reduction of 18,000 dental hygienists from the workforce. Dentists have indicated that the dental hygiene labor market has tightened considerably; data collected for the week of October 5 indicate that one-quarter of dental offices reported they had recently hired or were actively recruiting dental hygienists.[8] Among these dentists, more than three-quarters reported it was extremely or very challenging to fill vacant dental hygienist positions.[8] An estimated 90% of dentists received some type of financial relief from the federal government, including the Paycheck Protection Program, and this contributed significantly to maintaining demand for dental hygienists.

A key insight from this research is that the majority of dental hygienists in this study who left their jobs did so voluntarily. Further analysis suggests that most of this voluntary departure from the workforce is likely to be short-term or, more formally, lasting through the COVID-19 pandemic. But there is also a portion of dental hygienists who indicate they do not want to be employed as a dental hygienist any longer, even after the COVID-19 pandemic is under control. Results indicate that at least 0.5% of the dental hygiene workforce may be in this category of permanently leaving their jobs. Further investigation is needed to understand factors associated with dental hygienists' decisions to leave clinical practice. A qualitative study may illuminate dental hygienists' perceptions and plans to pursue other careers within the profession, find alternative career options outside of dental hygiene, or remain unemployed.

Another relevant finding is the issue of age and association with employment status. Results revealed that more dental hygienists age 65 years and older were not currently employed or voluntarily left their positions. Further study is needed to understand if there is a relationship between these individuals and those with comorbidities that place them at greater risk for SARS-CoV-2.[10] Respondents' choice to remain out of work could have been impacted by physical health concerns and associated COVID-19 illness. Further study is also needed among dental hygienists age 45-54 who indicated they were permanently let go and the rationale for their termination.

The results of this study also provide additional evidence of how COVID-19 is bringing unique challenges to women in the workforce. Dental hygiene has traditionally been a female-dominated profession and these results provide another example of how childcare issues are playing an exaggerated role during the COVID-19 pandemic in driving career choices. While these unique childcare issues are likely to resolve as the pandemic subsides and schools and childcare facilities reopen, there is emerging evidence that COVID-19 may have long-term consequences for earnings and career prospects of women.[11]

Regarding dental hygienists' concern for contracting COVID-19 in the workplace, this study confirms PPE availability is an important factor. Dental hygienists with higher stockpiles of N95 or KN95 masks in their place of employment reported lower levels of concern. Further, analysis also found that a small percentage of dental hygienists did not actually know how many days' worth of N95 of KN95 masks were in stock at their place of work. This finding is concerning because participants may be making decisions regarding their employment status without full knowledge of PPE availability and not utilizing national guidance to evaluate whether supplies are sufficient for patient volume.

Concern over adherence to workplace safety standards, which could reflect PPE practices as well as many other factors, was also important for 13% of the participating dental hygienists in terms of influencing their decision to voluntarily leave their job. In the recent ADA study, researchers found that 99% of dental offices in the US were using some form of enhanced infection control as a result of COVID-19 and that 73% were using PPE according to interim guidance from the Centers for Disease Control and Prevention (CDC).[9] While PPE stockpiles in dental practice settings have improved considerably in the past months, certain items such as N95 masks and gowns are still in relatively short supply.[9] Reference to PPE shortages appears to be a worldwide concern. Dental hygienists responding to the survey conducted by the IFDH demonstrated that current PPE was limited in terms of goggles (46%) and full gown (48%), and not all practitioners were provided gloves (86%), face shields (76%), or surgical masks (69%).[6] Over 80% of the international respondents expressed concern that there would not be an adequate supply of PPE to treat patients.[6]

Lastly, with the onset of administration of vaccines in the US, some dental hygienists may decide to reenter the workforce in the near future. Two vaccines, mRNA-1273, (Moderna, Inc.) and BNT162b2 (Pfizer BioNTech) have received emergency use authorization from the US Food and Drug Administration, and are being provided to health care workers and residents in long-term care facilities.[12] Dental and dental hygiene national

associations have advocated for oral health care workers to be among the first groups to receive the vaccine recognizing that they are essential health care workers and play a critical role in addressing significant oral and systemic health conditions.[13-15] Furthermore, dental hygienists can also play a primary role in addressing COVID-19 by being part of the CDC vaccination response. Administering vaccines, as recently approved in the state of Connecticut,[16] and educating patients about the need for vaccination for pandemic prevention and control, are examples of measures illustrating ways dental hygienists can support positive changes in addressing the COVID-19 pandemic in workplace settings.

This study is not without limitations. The research is based on self-reported data, which may be influenced by recall or social desirability bias. However, this study represents only the beginning of an ongoing effort to understand the impact of COVID-19 on the employment of dental hygienists. Future research using data from this longitudinal study will continue to examine employment factors among dental hygienists in the US and determine the extent to which the COVID-19 pandemic has a permanent effect on their employment. Factors that may influence dental hygienists' decisions to return to work should be further explored from both a quantitative and qualitative perspective.

Conclusion

Results from this study provide the first empirical insight into the impact of COVID-19 on dental hygiene employment. Taken together, the analysis suggests COVID-19 has led to a significant reduction in the dental hygiene workforce that is likely to persist until the pandemic passes. The labor market for dental hygienists has tightened, with significant recruitment challenges being reported by dentists looking to hire dental hygienists. Results also indicate there will likely to be a much smaller, but longer lasting impact, as a small share of dental hygienists permanently leave the workforce.

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Research

Dental Implant Hygiene and Maintenance Protocols: A survey of oral health practitioners in Australia

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Abstract

Purpose: Dental implant care and maintenance is of critical importance as implants grow in popularity as a tooth replacement option. The purpose of this study was to investigate the implant-related training and clinical practices of oral health practitioners (OHPs) in Australia regarding oral hygiene instructions (OHI) and maintenance protocols, and to better understand their role in providing peri-implant services.

Methods: A 42-item web-based survey was forwarded to the members of the Dental Hygienists Association of Australia and the Australian Dental and Oral Health Therapists' Association. Survey items included participant's demographics, types of peri-implant services provided in the workplace, implant-related information sources, peri-implant diagnostic preferences, implant maintenance protocols and oral hygiene instructions (OHI) for dental implants. Descriptive statistics were used to analyse the data. Comparisons were made with a similar survey of the implant maintenance preferences of general dentists in Australia.

Results: One hundred fifty-four Australian OHPs completed the electronic survey (n=154). Nearly all respondents (96.7%) considered implant home hygiene and peri-implant health to be strongly associated. Dental qualification (64.9%) and association-sponsored professional development courses (50.6%) were the most common sources of implant assessment/management information. Brushing (88.7%) and the use of an interdental brush (78.1%) were the most popular implant-specific OHI provided. All of the respondents reported performing oral hygiene assessments around dental implants; 94.0% performed supragingival cleaning, 67.5% subgingival cleaning, 55.0% treated peri-implant mucositis and 38.4% peri-implantitis. Dental floss (80.9%), rubber-cup prophylaxis (59.6%), plastic/carbon curettes (52.5%) and plastic-tipped ultrasonics (43.3%) were the most common devices used for implant maintenance.

Conclusion: Australian OHPs reported providing peri-implant services generally in agreement with the current literature and demonstrated a greater focus on prevention as compared with Australian dentists. Oral health practitioners in Australia expect to be highly involved in dental implant maintenance care and provide the majority of preventive, periodontal and OHI services in their workplaces.

Keywords: dental implant maintenance, oral hygiene instruction, peri-implantitis, professional development, dental hygienists, dental therapists, oral health therapists, oral health practitioners

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Introduction

Dental implant care and maintenance is of critical importance as implants gain in popularity and a greater understanding of the rates of peri-implant disease is established. A recent meta-analyses identified the weighted mean prevalence of mucositis at the patient level to be between 43-46.8% and peri-implantitis to be between 19.8-22%.[1,2] Peri-implantitis appears to have a non-linear and accelerating mode of progression[3,4] and its prevalence appears to be correlated with increased number of years in function.[2] Regular, ongoing assessments of dental implants is widely recommended to detect peri-implant pathology,[5-7] by utilizing diagnostic tools and procedures firmly established in the literature.[8,9] These tools include visual assessments, pocket depth probing, checking for suppuration, bleeding on probing

and other inflammatory signs, and evaluating radiographic bone levels. The incorporation and performance of these clinical procedures by dental practitioners in clinical practice has been infrequently investigated; however, dental hygienists in the United States (US) have been previously surveyed regarding their clinical and knowledge-seeking practices.[10]

Professional and at-home plaque control practices are critical in managing peri-mucositis,[11] a precursor to peri-implantitis.[12] The quantity and quality of literature to support patient-performed implant hygiene care practices is poor, with no standardized plaque control protocol within peri-implant management research to date. Professional treatment protocols for maintaining peri-implant health are also lacking,[13] and treatment procedures for mucositis[11] and peri-implantitis[14] are not well established. Studies vary widely regarding disease criteria[15] and control group procedures, and lack long-term follow-up.[16-18] Although interventions are often successful, entire treatment protocols, including individual debridement, anti-infective, surgical, and antibiotic procedures, frequently lack comparison to control procedures, making their actual efficacy unknown.[16,19] Standardised diagnostic and inclusion criteria for peri-implant epidemiological research studies were only recently proposed by Renvert et al. in 2018.[9] Therefore, dental practitioners may vary widely in their preferences for oral hygiene care instructions and implant management protocols, in addition to their willingness to treat more severe peri-implant conditions.

Dental hygienists, dental therapists and oral health therapists, are collectively known as oral health practitioners in Australia. As of April, 2018, there were 4,467 oral health practitioners (OHPs) registered to practice in Australia[22] and 37.8% of Australian dentists indicated that they employed an OHP.[23] Services typically provided by OHPs both in the United Kingdom[24-26] and in Australia[27] have been identified as predominantly preventive.[27] In a study comparing private general dental practices in Adelaide, South Australia it was found that dentists who employed dental hygienists delegated many preventive and periodontal services to this OHP and had a significantly higher proportion of periodontal-focused services performed in their practices.[28] However, none of these cited studies differentiated the provision of periodontal versus peri-implant preventive and maintenance care, which may differ due to the less established care and maintenance protocols. The purpose of this study was to better understand the role Australian OHPs play in dental implant maintenance protocols by investigating their training, perspectives and clinical preferences in providing peri-implant oral hygiene instructions, diagnostic and maintenance care as compared with previously surveyed Australian dentists.

Methods

After considering the current literature on dental implant maintenance, a survey was developed in the Periodontics Department of the University of Melbourne Dental School to gather initial data on trends in implant dentistry information sources and treatment provision by OHPs in Australia. The survey was adapted from a web-based questionnaire previously used for general dentists by the same research group.[29] Survey design and validity testing were conducted by the periodontics department faculty, and ethics approval was granted by the Health Sciences Human Ethics Sub-Committee of The University of Melbourne. Five topic areas from the previous survey were replicated for inclusion in the adapted instrument: demographics (8 items), sources of implant-related assessment, maintenance and oral hygiene instruction (OHI) information (3 items), opinions regarding the correlation between patient home hygiene and peri-implant health (1 item), preferred implant-specific OHI, and diagnostic and implant maintenance procedures provided (18 items). Respondents were also asked to indicate their structured dental practice working relationships and the roles of the various dental practitioners in providing preventative, periodontal and implant procedures in their primary workplace setting (12 items). Most items involved selection of one or more multiple-choice responses. Respondents were able to provide additional information if their preferred response did not appear as one of the multiple-choice options.

The survey, hosted on Surveymonkey (San Mateo, CA, USA), was distributed by email to the members of the Dental Hygienists Association of Australia (1,100 e-mail addresses) and the Australian Dental and Oral Health Therapists' Association (1,772 email addresses), the national professional associations for OHPs in Australia. These professional associations were chosen for the survey distribution as they are the largest representative bodies for OHPs in Australia; the national practice registration body does not allow access to the registry database for research purposes. Following the initial email invitation to invitation to participate, a reminder was sent at four weeks and a prize drawing was conducted to encourage participation. Responses were collected over a three-month period in 2018. Data were described using SPSS statistical software, version 23.0 (SPSS, Chicago IL, USA), and compared to findings from a similar survey of general dentists in Australia (n=303)[29] with Chi-square tests performed (significance set at 0.05).

Results

Demographics and practice roles

A total of 154 Australian OHPs completed the survey (n=154) for an estimated minimum response rate of 5.4%, as some respondents may have belonged to both the Dental Hygienists Association of Australia and the Australian Dental and Oral Health Therapists' Association. The majority of respondents were female (92.9%), with a mean age of 38.4 years; had attained their dental qualification(s) from an Australian university (90.9%) and on the average, had been qualified since 2005. Most OHPs (79.9%) worked exclusively in a private practice located in a metropolitan area (59.1%).

A majority of OHPs (80%) reported that understanding the pathological process (90.3%), peri-implant tissue assessment (81.2%) and the maintenance of peri-implant health (85.1%) were within their scope of practice. About half considered that the treatment of peri-implant mucositis (50.0%) or peri-implantitis (50.6%) were within their scope of practice, however the respondents indicated that they played a smaller role in diagnosing peri-implant status (<40%) as compared to periodontal status (>70%). Provision of dental implant related services by practitioner type is shown in Table I.

Implant related education and training

Nearly two-thirds (64.9%) of respondents reported learning clinical procedures for implant assessment and management as part of their registrable dental qualification, followed by nearly one-half (50.6%) reporting continuing professional development (CPD) programs organised through professional associations. Other common sources of training and information were colleagues (48.1%), work-based mentorship (39%) and journal articles (42.9%). Only 16.9% of OHPs cited CPD sponsored by universities, followed by implant companies (14.3%) and hands-on courses (13.0%) as implant management and assessment information sources. When reporting sources of information for OHI for dental implants, similar rates were found. Compared to general dental practitioners (GDPs) who were similarly surveyed,[29] OHPs cited significantly higher rates of multiple information sources (p=0.001). Sources of information for implant assessment, management and OHI are shown in Table II.

Implant oral hygiene practices

Nearly all respondents (98.1%) indicated seeing patients with implants in their clinical practice setting. A majority (63.6%) considered the link between implant home hygiene

Table I. Provision of implant related services by dental provider type (n=143)*

		OHP alone %	Dentist** %	In-house specialist %	External referral %
Routine examination	Examination of new patient	9.1	80.4	9.1	1.4
	Examination of returning patient without implant(s)	21.0	72.7	4.9	1.4
	Examination of returning patient with implant(s)	16.8	75.5	6.3	1.4
Diagnosis	Diagnosis of periodontal disease	70.6	18.2	10.5	0.7
	Diagnosis of peri-implant health	38.5	53.2	8.4	0.0
	Diagnosis of peri-implant mucositis	29.4	58.0	10.5	2.1
	Diagnosis of peri-implantitis	23.8	59.4	11.2	5.6
Initial debridement, maintenance or treatment	No periodontal disease or implant	91.6	5.6	2.1	0.7
	Periodontal disease, no implant	91.6	2.8	4.2	1.4
	Peri-implant health	93.0	4.9	0.7	1.4
	Peri-implant mucositis	51.7	20.3	7.7	20.3
	Peri-implantitis	25.2	25.2	13.3	36.4
Provision of OHI	No periodontal disease or implant	97.2	2.8	0.0	0.0
	Periodontal disease, no implant	97.9	2.1	0.0	0.0
	Peri-implant health	97.2	2.8	0.0	0.0
	Peri-implant mucositis	83.9	10.5	1.4	4.2
	Peri-implantitis	77.6	9.8	3.5	9.1

* n varies as some respondents did not see dental implant patients in their main workplace

** Also includes dentists when consulted by OHP

Table II. Sources of information for clinical implant assessment/management procedures and implant OHI for oral health care providers (OHPs) and general dental practitioners (GDPs)

	OHP implant assessment and management information sources* %	OHP implant OHI information sources %	GDP implant OHI information sources %	*p*-value**
	(n=154)	(n=154)	(n=303)[29]	
Registrable qualification	64.9	63.6	38.0	<0.001
University-based CPD	16.9	(26)† 100.0	(115)† 58.3	—
Association/society CPD	50.6	(78)† >100.0	(184)† 59.8	<0.001
Implant-company CPD	14.3	(22)† 59.1	(188)† 45.2	0.015
Hands-on course	13.0	11.7	6.9	—
Work-based mentorship	39.0	36.4	24.4	0.007
Colleagues	48.1	46.8	35.0	0.015
Journal articles	42.9	36.4	36.6	—
Textbooks	27.9	15.6	15.8	—
No source cited	0.6	0	6.6	0.001

* Multiple selections permitted **p-values <0.05 shown

† Attended this type of CPD implant training; percentage citing it as a source of OHI was calculated based on attendance

and peri-implant health to be "very strong" followed by one-third (33.1%) who indicated it to be "strong." The most common OHI for a single implant-supported restoration provided by OHP respondents included the use of a toothbrush (88.7%), interdental brush (78.1%), interproximal flossing (66.2%) and circumferential flossing (62.3%). When compared to GDPs who were similarly surveyed,[29] OHPs were significantly more likely to recommend an interdental brush ($p=0.029$), circumferential dental flossing ($p<0.001$) and oral irrigator ($p<0.001$). Implant specific oral hygiene instructions by OHPs and GDPs are shown in Table III.

While a majority of the OHP respondents (75.2%) repeated the OHI at every review or recall appointment, 21.4% repeated OHI only if signs/symptoms of peri-implant disease were present. The OHI frequency preferences differed significantly overall from the GDPs previously surveyed,[29] particularly regarding regular repetition ($p<0.001$). Out of the three suggested communication methods, OHPs were most likely to demonstrate the OHI (96.6%) to their patients and while 49.0% asked the patient to demonstrate following instruction, both practices were significantly more frequent than the GDPs who were surveyed.[29] Oral hygiene instruction frequency and communication preferences by provider are shown in Table IV.

Professional maintenance protocols

Nearly all of the OHP respondents (99.4%) expected to be involved in peri-implant maintenance and expressed the belief that they had a role to play in implant patient care. The majority of respondents who see implant patients (96.7%) also reported performing implant checks and diagnostic procedures. Over 95% reported performing assessments of implant oral hygiene, soft tissues, pocket depths, bleeding on probing or suppuration; 85% reported assessing recession or implant mobility. Of the respondents performing implant checks, all diagnostic procedures were performed at significantly higher rates by OHPs than GDPs surveyed (Table V). The types of implant maintenance procedures provided, (supra- or subgingival implant cleaning during maintenance, treatment of peri-implant mucositis or peri-implantitis), decreased with increasing complexity of the type of procedure All procedure types were provided at significantly higher rates by OHPs than the GDPs similarly surveyed. When asked whether they would treat or refer mucositis, 12.6% of OHPs did not treat or refer peri-implantitis; proportions similar to the GDPs surveyed (Table V).

A small proportion (6.6%) of OHPs who see implant patients did not use any implant-specific instruments or techniques in professional maintenance, significantly lower

Table III. Post-restoration implant-specific oral hygiene instructions for a single implant-supported restoration and implant specific diagnostic procedures by provider type

	OHPs who see patients with implants %	GDPs %	*p*-value*
	(n=151)	(n=303)[29]	
Brushing	88.7	86.5	—
Flossing	66.2	73.9	—
Superfloss™ (Oral-B®; Procter & Gamble Co., Cincinnati, OH, USA)	50.3	41.9	—
Interdental brush	78.1	68.3	0.029
Circumferential flossing	62.3	41.3	<0.001
Oral irrigator	34.4	17.8	<0.001
Mouthwash	16.6	14.5	—
Topical agent	2.6	1.0	—
None of the above techniques	3.3	3.0	—
	OHPs performing implant checks %	**GDPs performing implant checks %**	***p*-value***
	(n=146)	(n=291)[29]	
Oral hygiene assessment around implant	100.0	97.3%	0.043
Soft tissue visual assessment	99.3	94.5	0.014
Pocket depth probing	96.6	82.1	<0.001
Assessment of bleeding on probing	97.3	88.7	0.002
Assessment of suppuration	95.2	73.9	<0.001
Recession measurement	85.6	56.0	<0.001
Assessment of implant mobility	84.9	70.4	0.001

p-values <0.05 shown

than the GDPs surveyed (19.1%, n=303; $p<0.001$). Among the OHPs who used implant specific techniques (n=141), flossing was the most popular (80.9%), followed by rubber cup/brush prophylaxis (59.6%) and plastic/carbon curettes (52.5%). Plastic ultrasonic scaler tips (43.3%) were more than twice as popular as stainless-steel ultrasonics (19.9%). GDPs surveyed were more likely to use rubber cup prophylaxis ($p=0.004$) and stainless-steel ultrasonics ($p<0.001$), while OHPs were significantly more likely to use air-powder polishing, plastic ultrasonics and titanium curettes ($p\leq0.001$). Peri-implant procedures/treatment and techniques used in professional maintenance by provider type are shown in Table V.

Discussion

At the time of the survey, Australian OHPs (dental hygienists, dental therapists, oral health therapists) could only provide dental services within a structured professional relationship with a dentist.[30] Nearly all of the OHP respondents (99.4%) in this study expected to be involved in peri-implant maintenance and believed that they had a role to play in implant patient care. Respondents also demonstrated a positive preventative attitude regarding dental implants with 96.7% considering the link between implant home hygiene and peri-implant health to be strong. The provision of OHI (>97%) and periodontal debridement (>91%) by OHPs in this study was comparable to those of a subset of dental hygienists working with GDPs, in a survey of periodontal service provision in Victoria, Australia.[31] Results from this study provide initial insight into the provision of implant-specific diagnosis, peri-implant maintenance and OHI by different practitioner types in the practices employing OHPs.

Dental practitioners provide services according to their scope of practice. The relatively recent addition of implantology to dental practice impacts the variety of education sources, including the dental qualifications, dental association/society CPD and the work environment sources most commonly reported in this study. An interesting finding in this study was the much lower attendance reported from university-based and implant-company provided CPD as compared to professional association provided CPD. This may represent differences in availability or accessibility of programs from continuing professional education providers, and is similar to the university-based program attendance of the previously surveyed GDPs.[29] There are implications for the ongoing development of implant education in Australia based on the findings from this study and perhaps more professional development courses need to be made available to OHPs.

Inclusion of implant OHI in implant

Table IV. OHI frequency and communication preferences

Implant OHI	OHPs who provide implant OHI %	GDPs who provide implant OHI %	*p*-value*
	(n=145)	(n=289)[29]	
Frequency preference			
Repeat at every recall or review	75.2	57.4	<0.001
Repeat only once at next recall or review	3.4	13.5	
Repeat only if signs/symptoms present	21.4	27.0	
Do not repeat	0	2.1	
Instruction method			
Describe to the patient	73.8	76.5	—
Show the patient	96.6	84.1	<0.001
Ask the patient to demonstrate after instruction	49.0	36.3	0.011

**p* values <0.05 shown

Table V. Peri-implant procedures/treatment provided, and instruments/techniques used in professional maintenance

	OHPs who see patients with implants %	GDPs %	*p*-value*
	(n=151)	(n=303)[29]	
Supragingival/superficial implant prosthesis cleaning during recall/periodontal maintenance	94.0	77.9	<0.001
Subgingival debridement of implants/implant surface during recall/periodontal maintenance	67.5	35.0	<0.001
Treatment of peri-implant mucositis	55.0	41.9	0.009
Do not treat nor refer for peri-implant mucositis	10.6	14.5	—
Treatment of peri-implantitis	38.4	18.2	<0.001
Do not treat nor refer for peri-implantitis	12.6	16.5	—
	OHP maintenance instruments/techniques %	**GDP maintenance instruments/techniques %**	***p*-value***
	(n=141)	**(n=245)[29]**	
Floss	80.9	76.3	—
Rubber cup/brush with prophylaxis paste	59.6	73.9	0.004
Air powder polishing/prophylaxis	29.8	9.8	<0.001
Stainless steel ultrasonic scaler	19.9	38.0	<0.001
Plastic ultrasonic tips	43.3	26.5	0.001
Stainless steel curettes	16.3	15.5	—
Plastic/carbon curettes	52.5	43.3	—
Titanium curettes	29.8	12.7	<0.001
Topical antimicrobials	39.7	32.2	—
Interdental brush (volunteered answer)	2.1	—	—
Superfloss™ (volunteered answer)	1.4	—	—

**p*-values <0.05 shown

training was reported in higher frequencies by the OHP respondents as compared with the GDPs previously surveyed.[29] This may reflect the expected OHP preventative focus from education through to clinical practice which, by comparison, may indicate the need for a greater emphasis on prevention in the implant education system available to GDPs. Differences between implant OHI sources cited by OHPs and GDPs may also be due to the later mean graduation year (2005 for OHPs compared to 1998 for GDPs[29]) and the team-focused OHP work environment which encourages work-based mentorship and learning.

Patient-performed implant hygiene forms a critical part of mechanical plaque control, and is considered the standard of care for mucositis management along with professional plaque control.[11,12] OHPs in this study demonstrated a strong understanding of the close link between implant home hygiene and peri-implant health. However, there are no evidence-based patient-performed protocols related to preventative efficacy[16,32] nor an established standard hygiene control for clinical research[33] reported in the literature. Dental practitioners may be inferring their implant OHI preferences based on the periodontal literature or their own clinical experiences. In this study, the interdental brush was the most commonly recommended interdental cleaning method, in agreement with the current periodontal literature, deeming it the most efficacious interdental cleaning method,[34] although evidence for peri-implant efficacy is limited.[35] While interproximal flossing and circumferential flossing were the second and third most frequently recommended techniques, the use of dental floss has recently been identified as a possible peri-implantitis risk factor in implants with exposed rough surfaces, due to the retention of floss fibers.[36] The higher recommendations of circumferential flossing and oral irrigator use by OHPs, as compared to GDPs, may be due to the promotion of these techniques in the dental hygiene literature.[37]

Nearly all OHP respondents demonstrated the recommended OHI technique, significantly more than the GDPs surveyed,[29] and more in agreement with the OHI communication efficacy literature, where intra-oral demonstration has been shown to be more effective than written or verbal explanation.[38] OHP respondents were also more likely than GDPs to ask their patients to demonstrate the technique, a possible contribution to a higher internal locus of control, which has been shown to be important in changing oral hygiene behaviors.[39,40] While the majority of OHPs respondents were generally more preventation focused in repeating OHI at every recall/review appointment compared to GDPs,[29] nearly one-quarter of both groups only repeated OHI when signs/symptoms of disease were present. Repetition of individualised OHI is strongly recommended in the prevention of periodontal disease,[41,42] and all practitioners should reinforce pre-emptive implant OHI over the long-term, especially considering the challenges of treating peri-implant disease.[14]

Diagnostic procedures for peri-implant monitoring are well-established in the literature[8,9] and OHPs in this study performed them at high rates (>90%). Similar proportions of OHPs (10%) and GDPs (17%) surveyed reported either not treating nor referring cases of peri-implant mucositis or peri-implantitis. Given the potential severity and difficult management of peri-implantitis,[15,43] timely coordinated management by all practitioners and appropriate referrals should be reinforced in clinical practice and education programs. Possible reasons for this finding are unknown and should be investigated in the future. In general, the OHP respondents provided comprehensive implant diagnostics and all types of peri-implant maintenance, using implant-specific instruments/techniques, at significantly higher rates than the GDPs similarly surveyed.[29] Provision of peri-implant diagnosis, maintenance and treatment of peri-implant pathologies in a general dental practice may vary widely depending on whether OHPs are employed in the practice. Findings from this study may reflect a greater focus on preventative care by OHPs, as expected from their role in clinical practice. Further research is needed to investigate why GDPs do not have an equally preventative, implant-specific attitude towards implant maintenance care, especially considering that less than one-half of all Australian GDPs (37.8%) employ an OHP and GDPs are responsible for maintaining implant patients on their own.[23]

There are no standard evidence-based protocols for the treatment of peri-implantitis[14] or peri-implant mucositis,[17] nor the maintenance of peri-implant health.[13,33] Dental practitioners' preferred use of maintenance instruments and techniques given the uncertainty in the literature has rarely been investigated: periodontists have been surveyed in the UK, Australia[21] and the US.[20] In this study, higher usage of air-powder polishing and plastic ultrasonic tips and lower usage of stainless-steel ultrasonics by OHPs compared to GDPs is in closer agreement with the available literature supporting the efficacy of and minimal damage from air powder polishing[44-46] and plastic ultrasonics,[46,47] although recent *in vitro* studies have shown plastic debris remaining after plastic ultrasonic use.[48,49] However, OHPs reported higher titanium curette usage which, while not exempt[50,51] from metal instruments causing surface scratching *in vitro*,[48,50-53] may do so at lower levels.[49] Plastic curettes were also popular amongst OHPs in this study, although they may

be too large[54] or ineffective at cleaning.[46] Antimicrobial use was similar in this study was similar to dental hygienists in the US,[10] however, while chlorhexidine was recommended in the recent American College of Prosthodontists' Clinical Practice Guidelines,[7] its adjunctive use in clinical trials has not resulted in better treatment outcomes.[55-57] Current evidence-based maintenance methods should be comprehensively covered in implantology education for all practitioners.

This study had limitations. The sample size in this study was much smaller than the respondents (n=1083) in a repeatedly mailed paper survey to the same dental hygienist, and dental and oral health therapist association member lists in 2013.[27] Web-based surveys of dentists have been shown to have lower response rates (11%) than mailed surveys (26%).[58] The relatively small sample size in this study was similar to previously published research of dental implant clinical and knowledge-seeking practices of dental hygienists in the US (n=213).[10] With a response rate of at least 5.4% from the professional associations' member lists, a representation rate of 3.5% of the registered Australian OHPs,[22] results from this study were similar to other recent web-based surveys of Australian dental practitioners.[29,59,60] Some OHP respondents may have been members of both associations impacting the response rate. The lack of access to the Australian national registry database, limits the ability to effectively access all OHPs and the interpretation of this study findings.

In general, the demographics of the surveyed group were similar to the most recently available dental labor force report in Australia in 2012.[61] Participants may have self-selected based on greater interest in implantology and self-reported answers may not be completely reflective of clinical practice. Full-time or part-time employment status of respondents was not asked and may affect their involvement in implant maintenance. Although a pilot test was not conducted, the survey instrument was intended to gather initial data on implant maintenance trends in the OHP population, and provides previously undocumented insight into the training, role and attitudes of Australian OHPs in implant maintenance, and may indicate future directions for research and investigation. The structure of dental service provision in Australia in terms of the scope of practice for OHPs and the structured interprofessional relationships within dentistry may be quite different from other countries and should be considered when interpreting and comparing these results. Variations and availability of implant CPD programs for Australian OHPs and the influence of collaboration with dentists/specialists in clinical practice should be further investigated. Practitioners should be encouraged to stay abreast of the current literature as evidence for implant home care and maintenance protocols continue to develop.

Conclusion

Australian OHPs expect to be highly involved in dental implant maintenance care and reported providing peri-implant services generally in agreement with the current literature. Oral health practitioners demonstrated a greater focus on peri-implant disease prevention as compared with Australian dentists whose involvement was higher for patients with more severe peri-implant pathologies. Oral health practitioners should continue to focus on evidence-based practices in OHI and dental implant management protocols for peri-implant disease prevention. Interprofessional collaboration, dental implant focused continuing education programs and evolving practitioner preferences for implant maintenance protocols should continue to be investigated to enhance patient outcomes.

Disclosure

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Research

Acceptance of Dental Office Obstructive Sleep Apnea Screening among Minnesota State Fair Attendees

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Abstract

Purpose: Obstructive sleep apnea (OSA) is a common breathing disorder; however, many individuals remain undiagnosed. The purpose of this study was to assess the comfort level of community-dwelling adults to participate in OSA screening in a dental office setting and survey the OSA risk levels of an adult population.

Methods: This cross-sectional study was conducted among adults presenting at the University of Minnesota Driven to Discover Research Facility during the 2018 Minnesota State Fair. Participants completed a brief survey including the eight-item STOP-Bang questionnaire for OSA screening. Electronic tablets were used for data capture. Data analyses included descriptive statistics, t-tests, and Chi-square tests.

Results: A total of 639 adults met the survey inclusion criteria (n=639). The majority of participants (88%) reported no prior OSA diagnosis. Based on STOP-Bang criteria, 61% (n=344) of the participants were at low, 29% (n=161) intermediate, and 10% (n= 56) high risk of OSA. A majority (64%) of participants reported being either "comfortable" or "very comfortable'"with OSA screening performed in a dental office setting.

Conclusion: Over one third of participants with no prior OSA diagnosis were at moderate to high risk for OSA, and the majority stated that they would be comfortable undergoing OSA screening in a dental office setting. Dental hygienists screening patients for OSA with the STOP-BANG questionnaire are likely to have a high level of patient acceptance. Referring patients to the appropriate health care provider for further testing may increase timely diagnoses and treatment of OSA.

Keywords: obstructive sleep apnea, sleep disordered breathing, STOP-Bang questionnaire, health screenings, dental hygienists

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Introduction

Sleep disordered breathing (SDB) has risen along with obesity in the United States (US). A recent estimate of the prevalence of mild to severe SDB is projected to be 26% for persons 30–70 years of age.[1] Although obstructive sleep apnea (OSA) is one of the most common sleep disorders among US adults, an estimated 80% of cases remain undiagnosed.[2,3] Obstructive sleep apnea is characterized by repetitive collapse of the airway during sleep,[4,5] followed by arousal, which reverses airway collapse and restores normal oxygenation and ventilation. These episodes are associated with dysfunction of the autonomic nervous system and increases in oxidative stress.[6] These episodic processes may explain the association between OSA and cardiovascular diseases including hypertension, heart failure, arrhythmias, and stroke.[7, 8, 9] Of specific relevance to oral health care providers, OSA has also been identified as a contributing factor to inflammation, as measured by elevated levels of inflammatory cytokines,[10] with several studies reporting an association with periodontal disease.[11-14]

Key risk factors for OSA include obesity, hypertension, large neck circumference, advanced age, and male gender.[4,15] Symptoms of OSA include general fatigue and excessive daytime sleepiness; loud snoring; and witnessed apneic events.[4] A useful clinical screening tool that is rapidly becoming the standard for a quick OSA assessment is the 8-item STOP-Bang questionnaire (see Figure 1).[16] The instrument consists of four subjective items (STOP: Snoring, Tiredness, Observed apnea, and high blood Pressure) and four demographic items (Bang: BMI, age, neck circumference, and gender).[17] Total STOP-

Figure 1. STOP-Bang Questionnaire[20]

***S**noring:* Do you snore loudly (loud enough to be heard through closed doors)?	Yes	No
***T**ired:* Do you often feel tired, fatigued, or sleepy during daytime?	Yes	No
***O**bserved*: Has anyone observed you stop breathing during your sleep?	Yes	No
*Blood **P**ressure*: Do you have or are you being treated for high blood pressure?	Yes	No
***B**MI*: BMI more than 35 kg/m^2?	Yes	No
***A**ge:* Age over 50 years old?	Yes	No
***N**eck circumference:* neck circumference greater than 40 cm?	Yes	No
***G**ender:* Male?	Yes	No

Legend: Yes=1, No=0

Scoring: High risk of OSA: Answered 'yes' to 3 or more questions

Low risk of OSA: Answered 'yes' to less than 3 questions

Bang scores range from 0 to 8, with scores of 0-2 indicating low risk for OSA, whereas scores of 3 or more, demonstrate a significantly increased risk of OSA.[5] The questionnaire can be completed in 1-2 minutes and requires minimal training to administer.

Patients assessed at increased risk for OSA should be referred to the appropriate health care specialist for further testing and diagnosis. A definitive OSA diagnosis is obtained by conducting a polysomnograph (i.e., sleep study), in consultation with a sleep medicine physician.[10,18] Based on this essential information, the etiology and severity of the OSA is determined, followed by an appropriate treatment plan. Continuous positive airway pressure (CPAP) is the gold standard treatment for most patients diagnosed with OSA. The CPAP uses high pressure to force air through the airway to prevent collapse during periods of sleep.[4]

For individuals who are intolerant of CPAP treatment (25-58%), other treatment options are prescribed.[19] Mandibular advancement devices (MAD) are oral devices that advance the mandible and tongue to prevent the collapse of the upper airway during sleep.[20-22] These devices are fitted and maintained in dental settings, in collaboration with medical professionals. Several visits are often required to adjust these devices to the ideal position for patients. Similar to the CPAP, patient compliance is a concern, with only 32% of patients using an oral appliance regularly.[23] Long-term compliance is also a concern, with many as 55% of patients stopping use of the oral appliance within the first year. Of those who discontinued treatment, 62% reported an inability to adapt to the device and 38% reported temporomandibular pain associated with device use.[23] Additional treatment options include airway surgery and hypoglossal nerve stimulation during sleep.[24] Successful treatment has been shown to improve both quality of life and cardiovascular outcomes.[24,25]

Dental hygienists are well-positioned to screen and refer patients for further diagnostic testing, due to their knowledge of head and neck anatomy and because routine dental visits often occur at a higher frequency than primary care visits.[26] While the STOP-Bang questionnaire can easily be used in dental offices to identify patients at risk for OSA, it is not clear whether patients would be comfortable undergoing OSA screening during dental visits. The purpose of this study was to determine individuals' comfort level in completing the STOP-Bang questionnaire in the dental office setting. Secondary goals were to determine the proportion of patients at risk for OSA in an adult population and assess their most recent dental and medical visits.

Methods

This descriptive study was conducted among a convenience sample of adult attendees at the Minnesota State Fair in August 2018. A short survey was administered during two five-hour data gathering sessions at the University of Minnesota Driven to Discover Research Facility. The study was described to potential participants who approached the study booth, and written consent was obtained. Subjects were asked to complete the survey using an electronic device with a touchscreen. Research staff were available to assist participants who needed technical assistance. No personal identifying information was obtained from the participants. Inclusion criteria were age 18 and older and English literacy.

A brief original survey was designed for specific use in this study. Demographic and health history questions were included to assess participants' most recent medical and dental care visits, age and sex assigned at birth, and prior medical diagnoses. Prior medical diagnoses questions (yes/no) included OSA, hypertension, cardiovascular diseases, stroke, periodontal disease, and diabetes. The risk of OSA was determined using the STOP-Bang questionnaire. The final item asked the participant's level of comfort completing a similar survey in the dental office setting: response choices used a 5-item Likert scale, ranging from 5=very comfortable, to 1=very uncomfortable.

While the overall survey instrument was not validated, the psychometric properties of the STOP-Bang questionnaire have been tested extensively.[27] Development of the instrument was

based on initial factor analysis of the STOP questionnaire components, selected from 14 initial questions designed to reflect snoring, daytime tiredness, observed breathing cessation, and high blood pressure. The "Bang" items were chosen based in univariate analysis of items predictive performance. Subsequent analysis have focused on the predictive validity of the screening instrument compared to definitive sleep study results. In a recent meta-analysis, the instrument sensitivity was shown to be high (90 to 96%) although specificity was somewhat low (25-49%).[17] This combination of high sensitivity and lower specificity allows the questionnaire to capture almost all participants who truly have OSA for further diagnostic screenings, which uses the definitive sleep study to rule out OSA diagnosis for those not having it.

The study was submitted to the University of Minnesota Institutional Review Board and deemed exempt from further review. The study staff communicated to participants that study participation was not a substitute for a medical assessment. Resources and educational materials were available for participants who were concerned regarding their OSA risk. A paper copy of the STOP-Bang was available for attendees to take home and complete, that included scoring and follow-up recommendations. Referral to a medical provider was also available for interested participants.

Analysis included calculating participants' risk of OSA using the standard scoring of the STOP-Bang questionnaire. Scores of 5-8 were deemed high risk, scores of 3-4 moderate risk, and scores of 0-2 low risk.[28] Descriptive statistics (means and standard deviations for continuous measures; counts and proportions for categorical measures) were used to describe the sample. Characteristics were compared between those with and without an OSA diagnosis and between OSA risk categories (low, moderate, high) for those with no prior OSA diagnosis using two-sample t-tests or one-way ANOVAs for continuous variables and Chi-square tests for categorical variables.

Results

A total of 646 adults completed the survey. Responses from seven participants were excluded from the analysis due to participants not providing written consent, despite completing the survey, for a sample size of 639. Table I displays the characteristics of the study participants. The majority of participants were female (59%) with a mean age (standard deviation [SD]) of 51.1 years (17.0). A majority reported having a medical (83%) or dental visit (84%) within the past year. The most frequently reported OSA comorbidity was high blood pressure (22%) followed by periodontal disease (15%). Nearly two-thirds (64%) indicated that they would be "very comfortable" or "comfortable" completing an OSA screening questionnaire in a dental office setting.

The characteristics of participants with and without an OSA diagnosis are displayed in Table II. As expected, those diagnosed with OSA were older ($p<0.001$), more likely to be male ($p<0.001$), had more recent medical visits ($p=0.014$), and a higher prevalence of diabetes ($p<0.001$) and hypertension ($p<0.001$). No statistically significant differences were found for the most recent dental visit or level of comfort with OSA screening in a dental office. Characteristics of participants that had not previously been diagnosed with OSA by STOP-Bang risk category are shown in Table III. Participants in higher risk categories were more likely to be older ($p<0.001$) and male ($p<0.001$). A majority of participants with a high-risk score reported visiting a medical (50%) or dental provider (55%) in the last 6 months. The majority of all risk groups were "very comfortable" or "comfortable" with OSA screening in a dental setting. No statistically significant differences were found by risk category for most recent medical or dental visit, or comfort with OSA screening in a dental office.

Table I. Demographic characteristics (n=639)

Characteristic	n (%)
Sex assigned at birth	
Male	261 (40.8)
Female	378(59.2)
Last medical visit	
Less than 6 months ago	343 (53.7)
6-12 months ago	185 (29.0)
13-24 months ago	63 (9.9)
2-5 years ago	35 (5.5)
More than 5 years ago	13 (2.0)
Last dental visit	
Less than 6 months ago	388 (60.7)
6-12 months ago	148 (23.2)
13-24 months ago	49 (7.7)
2-5 years ago	35 (5.5)
More than 5 years ago	19 (3.0)
Comfort with OSA screening in a dental office	
Very comfortable	229 (35.8)
Comfortable	178 (27.9)
Neutral	175 (27.4)
Uncomfortable	40 (6.3)
Very uncomfortable	17 (2.7)

Discussion

Obstructive sleep apnea is a common but often undiag-nosed medical disorder that is associated with numerous medical comorbidities including

Table II. Characteristics of the study population by prior OSA diagnosis (n=639)

Characteristic	No prior OSA diagnosis n (%)	Prior OSA diagnosis n (%)	*p*-value
Age, mean (SD)*	49.6 (17.2)	61.6 (11.4)	<0.001
Male	215 (38.3)	46 (59.0)	<0.001
	n = 561	**n = 78**	
Last medical visit			**0.014**
Less than 6 months ago	289 (51.5)	54 (69.2)	
6-12 months ago	165 (29.4)	20 (25.6)	
13-24 months ago	61 (10.9)	2 (2.6)	
2-5 years ago	33 (5.9)	2 (2.6)	
More than 5 years ago	13 (2.3)	0 (0)	
Last dental visit			**0.26**
Less than 6 months ago	334 (59.5)	54 (69.2)	
6-12 months ago	132 (23.5)	16 (20.5)	
13-24 months ago	45 (8.0)	4 (5.1)	
2-5 years ago	34 (6.1)	1 (1.3)	
More than 5 years ago	16 (2.9)	3 (3.8)	
Diagnosed dental and medical conditions			
Periodontal disease	81 (14.4)	14 (17.9)	0.52
Diabetes	32 (5.7)	14 (17.9)	<0.001
High blood pressure	109 (19.4)	32 (41.0)	<0.001
Stroke	5 (0.9)	2 (2.6)	0.21
Heart disease	27 (4.8)	8 (10.3)	0.06
Comfort with OSA screening in a dental office			**0.33**
Very comfortable	196 (34.9)	33 (42.3)	
Comfortable	158 (28.2)	20 (25.6)	
Neutral	157 (28.0)	18 (23.1)	
Uncomfortable	37 (6.6)	3 (3.8)	
Very uncomfortable	13 (2.3)	4 (5.1)	

*Standard deviation (SD)

heart disease, stroke, and periodontal disease. Risk factors for OSA, such as advanced age, male gender, obesity and large neck circumference are easily identifiable and can be rapidly assessed using the STOP-Bang questionnaire. Screening for OSA facilitates identification of high-risk patients who could benefit from further diagnostic testing and treatment.

Results from this study identified that, over half of participants who were not previously diagnosed with OSA indicated that they would be either "very comfortable" or "comfortable" completing OSA screening in a dental setting. Only 9.0% indicated that they would be "uncomfortable" or "very uncomfortable" completing OSA screening in the dental setting. These results suggest that the vast majority of adults in the general public may be willing to undergo OSA screening during dental visits. While no other studies of the general public are available, one previous study among dental patients found that approximately 50% expressed acceptance of OSA screenings in a dental office setting.[29] However, it should be noted that a variety of OSA screenings exist.

Currently there are few studies regarding OSA screening practices in dental offices and follow-up treatment after OSA diagnosis. One study conducted among practicing Minnesota dental hygienists reported that about 10% had an established OSA screening protocol in their practice settings and no single screening instrument was used more frequently than another.[30] In a separate study, dentists were surveyed to establish the frequency of OSA screening in the dental office.[31] While 76% of the dentists reported screening for OSA, only 14% screen every patient.[31] Unfortunately the low response rate (7%) of that study make the results difficult to generalize the population as a whole.[31]

In this study, most participants (76.4%) who were categorized as at moderate or high risk of OSA, based on the STOP-Bang scoring, did not report being previously diagnosed with OSA. This is consistent with the estimated 80% of moderate to serve cases of OSA in the US that are undiagnosed.[16] This high percentage of undiagnosed individuals may benefit from a screening intervention to help identify, diagnose, and provide treatment before serious medical conditions arise or worsen.

Daytime sleepiness due to OSA has been linked to multiple workplace and public health risks. Individuals with untreated OSA have a two-fold increases in workplace accidents.[32] Commercial drivers have been studied with concern over road fatigue and OSA effects, resulting in about 7% of motor vehicle accidents (MVAs).[32] Policies for commercial drivers have been developed related to their abilities to perform driving tasks safely, and discussion of the impact OSA on non-commercial drivers has begun.[33]

Table III. Participant characteristics with no prior OSA diagnosis by STOP-BANG OSA risk (n=561)

Characteristic	Low OSA Risk n (%)	Moderate OSA Risk n (%)	High OSA Risk n (%)	*p*-value
Age, mean (SD)*	45.7 (17.5)	55.6 (15.2)	56.7 (12.8)	<0.001
Male	75 (21.8)	94 (58.4)	46 (82.1)	<0.001
	n = 344	**n = 161**	**n = 56**	
Last medical visit				**0.23**
Less than 6 months ago	168 (48.8)	93 (57.8)	28 (50.0)	
6-12 months ago	104 (30.2)	43 (26.7)	18 (32.1)	
13-24 months ago	44 (12.8)	11 (6.8)	6 (10.7)	
2-5 years ago	22 (6.4)	10 (6.2)	1 (1.8)	
More than 5 years ago	6 (1.7)	4 (2.5)	3 (5.4)	
Last dental visit				**0.48**
Less than 6 months ago	210 (61.0)	93 (57.8)	31 (55.4)	
6-12 months ago	79 (23.0)	34 (21.1)	19 (33.9)	
13-24 months ago	28 (8.1)	14 (8.7)	3 (5.4)	
2-5 years ago	18 (5.2)	14 (8.7)	2 (3.6)	
More than 5 years ago	9 (2.6)	6 (3.7)	1 (1.8)	
Comfort with OSA screening in a dental office				**0.21**
Very comfortable	130 (37.8)	53 (32.9)	13 (23.2)	
Comfortable	83 (24.1)	54 (33.5)	21 (37.5)	
Neutral	102 (29.7)	39 (24.2)	16 (28.6)	
Uncomfortable	22 (6.4)	10 (6.2)	5 (8.9)	
Very uncomfortable	7 (2.0)	5 (3.1)	1 (1.8)	

*Standard deviation (SD)

In addition to performance issues, OSA is associated with safety concerns for patients undergoing surgery requiring anesthesia. Individuals with OSA are at a higher risk for cardiovascular and cardiopulmonary complications post-operatively.[34] Preoperative screenings for OSA, using the STOP-Bang, is recommended to identify patients with moderate to severe OSA risk.[17]

A percentage of participants in this study indicated that they had seen a dental provider within the last 12 months. Among moderate-risk patients, 79% of patients indicated that they had visited a dentist within 12 months. Among high-risk patients, 89% had visited a dentist within 12 months. Corresponding numbers for physician visits were 84% for intermediate-risk participants and 82% for high-risk participants. This suggests that there is opportunity for OSA screening at either the dental office or medical office for most at-risk patients. However, opportunistic screening medical offices is generally poor, as patients' primary complaints take diagnostic precedence, thus creating a need which could be filled by dental hygienists.[23]

The dental office may be an ideal setting for OSA screening, as dental hygienists have the necessary knowledge base to identify anatomical risk factors for OSA and preventative care dental visits occur on a regular basis. A recent study among practicing Minnesota dental hygienists found that participants viewed OSA as either an important, very important, or extremely important clinical disorder (92.9%) with similar responses regarding the importance of identifying patients with possible OSA (92.3%).[30] Recognizing the importance of OSA may indicate that dental hygienists would willingly incorporate OSA screening into routine dental hygiene care.

This study had limitations. First, this survey was completed at a research booth by participants who willingly approached the researchers and consented to the study and may not be representative of the general population. Participants in this study, due to selection bias, may be more comfortable completing questionnaires (e.g., the STOP-Bang) than members of the general population or the population that seeks regular dental care. Moreover, it is possible that participants who approached the research booth were more likely than members of the general population to seek either dental or medical care, thus the data for date of most recent dental and physician visits may be biased.

Based on these findings, further research is needed in several areas. The first is to determine the attitudes of dental hygienists regarding OSA screenings in clinical practice and appointment time management. Attitude measures will help project how these screenings can be incorporated into routine dental hygiene care appointments. Additional assessment of current screening protocols will establish further recommendations for development of an OSA screening,

referral, and OSA treatment protocol. It is also essential to determine how OSA screenings can be effectively implemented and how to collaborate with medical professionals to obtain a formal OSA diagnosis and assist in treatment implementation.

Conclusion

Results from this study demonstrate that a large proportion of community adults in Minnesota are at moderate to high risk for obstructive sleep apnea. These individuals would be comfortable undergoing screening for OSA in a dental office and had visited the dentist over the previous 12 months. Dental hygienists are well positioned to implement OSA screening and initiate referral protocols in Minnesota dental offices.

Disclosure

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Research

Predictors of Multiple Jobholding among Dental Hygienists in the State of Iowa

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Abstract:

Purpose: Little is known about the prevalence of multiple jobholding practices among dental hygienists or the factors contributing to these employment patterns. The purpose of this exploratory study was to examine predictors of multiple jobholding practices among dental hygienists in the state of Iowa.

Methods: A mailed paper survey was sent to all licensed dental hygienists (n=2080) in Iowa in May 2018. The dependent variable was whether hygienists worked more than one job in dental hygiene. Key independent variables included individual, family, and practice-related factors. Descriptive, bivariate, and binary logistic regression analyses were completed.

Results: A total of 1215 dental hygienists participated in the survey, for a response rate of 58%. Among respondents, 12.2% worked more than one job overall, with 10.7% working 2 jobs and 1.5% working three or more. Respondents who had at least a bachelor's degree, did not have children in the household, were not married, had worked more years at their primary job, and worked more hours per week, were more likely to hold multiple jobs after adjusting for other factors.

Conclusions: Consistent with national estimates, there was a high multiple jobholding rate among dental hygienists in Iowa. Multiple individual, family, and practice characteristics were found to be related to multiple jobholding, with the strongest predictors being the hygienist's highest level of education and the number of hours worked at the primary job.

Keywords: dental hygienists, multiple jobholding, employment patterns, dental hygiene workforce models

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Introduction

Population oral health and oral health disparities can be improved, in part, by encouraging participation of the dental workforce at, or near, full capacity. However, recent estimates from the Health Resources and Services Administration (HRSA) project that the supply of dental hygienists will outpace demand nationwide in the coming years.[1] Specifically, it is projected that from 2012-2025, there will be a 28 percent increase in the supply of dental hygienists, whereas demand for this workforce is expected to increase by just 10 percent. Workforce surpluses are associated with higher rates of unemployment and underemployment. One potential indicator of underemployment, of particular relevance to the dental hygiene workforce is multiple jobholding, defined as individuals who hold more than one job.[2]

From 1970 to 2017, the national multiple jobholding rate in the United States (US) has slowly declined from 6.2 percent to 4.9 percent.[3] However, there is considerable variation in multiple jobholding rates across demographic groups (e.g., by age, race/ethnicity, marital status)[4] and industries.[3] For example, women are more likely than men to work multiple jobs,[5] and workers in education and health service industries typically have higher multiple jobholding rates than those in agriculture or construction.[6] In 2010, among working women in the US, the dental hygiene occupation had the highest multiple jobholding rate across all industries and sectors, at 12.9 percent, followed by psychologists at 12.5 percent and postsecondary teachers at 11.9 percent.[6]

Reasons for the high multiple jobholding rate in dental hygiene have not been studied extensively, and peer-reviewed research on employment-related factors among dental hygienists has been lacking. However, several state workforce reports provide descriptive information about the dental

hygiene workforce. For example, a recent survey of the dental hygiene workforce in Florida found that among hygienists who had difficulty finding a position (51% of respondents), the main reasons for this difficulty were inadequate benefits, inadequate salary, and difficulty finding full-time employment.[7] Dental hygienist respondents in Maine reported much higher difficulty finding employment, with 87 percent reporting it was somewhat or very difficult to find employment in their geographic area.[8]

These workforce reports are also the primary source for assessing multiple jobholding variation among dental hygienists across states. Estimates of multiple jobholding vary from 15% in Maine to 25% in Pennsylvania, although survey questions are not standardized so comparisons should be interpreted with caution.[7–11] Other state workforce surveys have inquired about working in multiple sites, conflating hygienists who work for a single employer at multiple locations with those who work for multiple employers, limiting the interpretability of those studies.[12,13] There is the gap in the literature addressing multiple jobholding patterns and practices of dental hygienists. The purpose of this study was to describe the degree of multiple jobholding among dental hygienists in the State of Iowa, and to examine predictors associated with multiple jobholding.

Methods

A paper survey was mailed to all dental hygienists working in Iowa (n=2080) in May 2018. A postcard reminder was sent one week later, and a second paper survey was sent two weeks later to nonrespondents. Addresses and demographic information – including age and sex – were obtained from the Iowa Dental Board's 2017 re-licensure data. Dental hygienists were included in the sample if they had a primary work address in the state of Iowa or, if no primary work address was listed, had a mailing address in Iowa. Recipients were also given the option to complete the survey online. Survey items were original or were adapted from previous state or national dental hygiene workforce surveys.[7,8,12–16] The survey instrument was pretested by members of a project advisory committee who were knowledgeable about the dental hygiene workforce. Three dental hygienists (one working in private practice, one in public health, one in dental hygiene education), pilot tested the survey. Pre-testers and pilot testers provided feedback related to clarity and flow, and changes were made accordingly.

The dependent variable was self-reported multiple jobholding, defined as working more than one job in dental hygiene at the time of the survey. Independent variables included individual factors (age, sex, race/ethnicity, highest level of education, and urbanicity of home county), family factors (marital status, and whether there were children under age 18 living in the household), and practice-related factors (primary job setting, years at primary job, hours worked per week at primary job, satisfaction with the number of hours at the primary job, desired total work hours, and total work hours across all jobs). Urbanicity of home county was classified using the US Department of Agriculture's 2013 Rural-Urban Continuum Codes, which are determined by population size and adjacency to a metro area.[17] Codes 1-3 indicate urban counties, and 4-9 indicate rural counties.

Descriptive, bivariate (Chi-square), and binary logistic regression models were completed using SPSS Version 25 (IBM; Armonk, NY). Data were weighted in descriptive and bivariate analyses to account for differences in nonresponse by age group but were not weighted in regression modeling. Sex and race/ethnicity were excluded from bivariate analyses and regression modeling due to low response variance. Response categories for primary job setting and hours worked per week at the primary job were recoded for bivariate analyses and regression modeling to account for small numbers. For the primary job setting variable, the response category "private practice" included those who selected either "private practice" or "corporate/Dental Service Organization" (DSO) in the original response options. Age, hours worked per week, and years at primary job were categorized in descriptive and bivariate analyses for interpretability but retained as continuous variables for the regression model due to improved model fit. Home county urbanicity, desired total work hours, and hours worked per week at all jobs, were excluded from the final model due to lack of significance in bivariate analyses, and the latter two were also excluded due to the high degree of correlation with other variables. The Hosmer and Lemeshow test was used to determine model fit, and model assumptions were confirmed to be met. This project was approved by the University of Iowa Institutional Review Board (ID #201802842).

Results

A total of 1215 (58%) dental hygienists responded to the survey. Of those, 6% (n=75) were not currently working in Iowa and were therefore screened out of the remainder of the survey, and 94% (n=1140) completed the full survey. Respondents were primarily White (97.6%), female (99.7%), married (88.4%), and working in private practice (84.9%) (Table I). Approximately 53% were age 40+, 29.7% had at bachelor's degree or higher, and 56.8% lived in a rural county. Over half (56.5%) of respondents had children under

Table 1. Respondent demographic and practice-related characteristics (n=1141)

Individual factors	n (%)
Age in years	
<30	161 (14.1)
30-39	367 (32.2)
40-49	260 (22.8)
50+	353 (30.9)
Sex	
Female	1137 (99.7)
Male	4 (0.3)
Race	
White	1105 (97.6)
Other race or multiracial	27 (2.4)
Highest level of education	
Dental hygiene certificate	96 (8.5)
Associate degree	703 (61.9)
Bachelor's degree	309 (27.2)
Master's degree or higher	28 (2.5)
Urbanicity of home county	
Rural	630 (56.8)
Urban	478 (43.2)
Family factors	
Children under 18 living in household	
Yes	628 (56.5)
No	484 (43.5)
Marital status	
Married	983 (88.4)
Divorced, widowed, or separated	73 (6.6)
Never married	56 (5.0)

Practice factors	n (%)
Primary job setting	
Private practice	956 (84.9)
Corporate/DSO	50 (4.4)
Community Health Center	27 (2.4)
Community-based public health setting	36 (3.2)
Education program (DDS, DH, DA)	39 (3.4)
Other	17 (1.5)
Years at primary job	
0-5	479 (42.6)
6-10	201 (17.9)
11-20	279 (24.8)
21+	165 (14.6)
Hours worked per week at primary job	
8 or fewer	33 (3.0)
9-20	142 (12.8)
21-31	293 (26.2)
32+	648 (58.1)
Hours worked per week at all jobs	
8 or fewer	30 (2.6)
9-20	102 (9.1)
21-31	287 (25.6)
32+	700 (62.6)
Satisfaction with number of work hours at primary job	
Very satisfied	760 (66.8)
Somewhat satisfied	301 (26.5)
Dissatisfied	76 (6.7)
Desired total work hours	
More hours	95 (8.5)
Same number of hours	762 (67.9)
Fewer hours	265 (23.6)

age 18 living in the household. Respondents had comparable distributions of work hours whether taking into account the primary job only or total hours across all jobs, with 58.1% and 62.6% working 32+ hours, respectively. Most respondents were either very satisfied (66.8%) or somewhat satisfied (26.5%) with the number of work hours at their primary job. Only 8.5% desired additional total work hours.

Among the respondents, 12.2% worked more than 1 job, with 10.7% working 2 jobs and 1.5% working 3 or more. Respondents most likely to hold multiple jobs included those who had a bachelor's degree or higher ($p<.001$), did not have children in the household ($p=.026$), were not married ($p<.001$), worked in an education program ($p=.031$), had a shorter job tenure ($p=.002$), worked fewer hours at their primary job ($p<.001$) and were less satisfied with their work hours ($p<.001$) (Table II). The following variables were not significantly associated with multiple jobholding: age, urbanicity of home county, hours worked per week at all jobs, and desired total work hours.

Table II. Bivariate analyses examining multiple jobholding and respondent characteristics (n=1138)

	Work more than one job in dental hygiene n(%)		*p*-value
	Yes (n=139, 12.2%)	No (n=999, 87.8%)	
Individual factors			
Age in years			
<30	28 (17.4)	133 (82.6)	**.20**
30-39	43 (11.7)	323 (88.3)	
40-49	30 (11.5)	231 (88.5)	
50+	39 (11.1)	312 (88.9)	
Highest level of education			
Dental hygiene certificate or Associate degree	75 (9.4)	724 (90.6)	**<.001**
Bachelor's degree or higher	64 (19.0)	273 (81.0)	
Urbanicity of home county			
Rural	79 (12.6)	550 (87.4)	**.30**
Urban	50 (10.5)	425 (89.5)	
Family factors			
Children under 18 living in household			
Yes	65 (10.4)	563 (89.6)	**.026**
No	71 (14.8)	410 (85.2)	
Marital status			
Married	108 (11.0)	872 (89.0)	**<.001**
Divorced, widowed, or separated	11 (15.5)	60 (84.5)	
Never married	16 (28.6)	40 (71.4)	
Practice factors			
Primary job setting			
Private practice	121 (12.0)	885 (88.0)	**.031**
Education program	10 (25.6)	29 (74.4)	
Other	8 (9.9)	73 (90.1)	
Years at primary job			
0-5	79 (16.5)	400 (83.5)	**.002**
6-10	23 (11.4)	178 (88.6)	
11-20	22 (7.9)	257 (92.1)	
21+	14 (8.5)	151 (91.5)	
Hours worked per week at primary job			
20 or fewer	53 (30.1)	123 (69.9)	**<.001**
21-31	41 (14.0)	252 (86.0)	
32+	44 (6.8)	604 (93.2)	
Hours worked per week at all jobs			
20 or fewer	8 (6.1)	123 (93.9)	**.053**
21-31	35 (12.2)	252 (87.8)	
32+	96 (13.7)	604 (86.3)	
Satisfaction with number of work hours at primary job			
Very satisfied	73 (9.6)	684 (90.4)	**<.001**
Somewhat satisfied	46 (15.3)	255 (84.7)	
Dissatisfied	20 (26.3)	56 (73.7)	
Desired total work hours			
More hours	14 (14.6)	82 (85.4)	**.74**
Same number of hours	91 (11.9)	671 (88.1)	
Fewer hours	34 (12.8)	231 (87.2)	

In the logistic regression model, having children in the household ($p=0.02$), marital status ($p=.007$), highest level of education ($p<.001$), years at primary job ($p=.006$), and hours worked per week at primary job ($p<.001$) were significantly associated with multiple jobholding (Table III). Respondents who were not married were more than twice as likely as those who were married to hold multiple jobs, and those with a bachelor's degree or higher were more than twice as likely to hold multiple jobs compared to those with an associate degree or certificate. Increases in both the number of years and the number of work hours at the primary job were associated lower odds of multiple jobholding. Hosmer and Lemeshow test yielded $p=.631$ indicating evidence of good model fit.

Table III. Binary logistic regression model predicting multiple jobholding among respondents (n=1075)

Individual factors	OR (95% CI)*	*p*-value
Age in years	**.98 (.96-1.00)**	**.049**
Highest level of education		
Dental hygiene certificate or associate degree	.40 (.26-.60)	<.001
Bachelor's degree or higher	Ref	—
Family factors		
Children under 18 living in household		
Yes	Ref	—
No	1.71 (1.09-2.69)	.020
Marital status		**.007**
Married	Ref	—
Divorced, widowed, or separated	2.20 (1.06-4.58)	.035
Never married	2.53 (1.81-5.41)	.017
Practice factors		
Primary job setting		
Private practice	.80 (.43-1.50)	.49
Other	Ref	—
Years at primary job	**.96 (.94-.99)**	**.006**
Hours worked per week at primary job	**.92 (.90-.94)**	**<.001**
Satisfaction with number of work hours at primary job		**.049**
Very satisfied	Ref	—
Somewhat satisfied	1.58 (1.02-2.44)	.040
Dissatisfied	1.82 (.95-3.50)	.071

* Odds ratio (95% Confidence interval)

Discussion

The multiple jobholding rate among dental hygienists in Iowa (12.2%) is comparable to the national multiple jobholding rate among dental hygienists,[6] which is considerably higher than the recent multiple jobholding rate among all occupations nationwide (4.9%) as well as the overall multiple jobholding rate in Iowa (8.6%).[2] In contrast, Iowa's multiple jobholding rate for dental hygienists is lower than other states' estimates, which range from 15% in Maine to approximately 27% in Florida and Pennsylvania.[7,8,10,16]

In this study, individual, family, and practice factors all related to multiple jobholding among Iowa dental hygienists. The positive relationship between educational attainment and likelihood of multiple jobholding is consistent with estimates nationally and in other sectors.[6] Motivations for multiple jobholding have been found to differ by educational attainment; while individuals with lower educational attainment are driven by financial factors, those with higher educational attainment are more likely to be related to job satisfaction or career growth.[6] This trend is plausible in the dental hygiene workforce as well; dental hygienists with higher educational attainment could be more likely to hold teaching positions which are often part-time. A systematic review of multiple jobholding among the nursing workforce found that the main motivations for multiple jobholding were financial, dissatisfaction with the main job, and increased flexibility.[18] These specific factors were not addressed in this study, and future research could explore whether these relationships hold true in for dental hygienists.

Results regarding family factors are consistent with other studies, including the finding that single women are more likely to work multiple jobs than their partnered counterparts.[6,19] While it would seem that this relationship could be explained by the financial pressures of a single-income versus a dual-income household, the national trend is reversed for men; married men are more likely to work multiple jobs than their non-partnered counterparts.[6] While there is a paucity of literature examining multiple jobholding and the presence of children in the household, it is likely that childrearing responsibilities among this primarily female workforce override the desire or ability to work multiple jobs.

The reasons for the high multiple jobholding rate for the dental hygiene profession as a whole, compared to other occupations, are not well understood. This study's finding that dental hygienists who work multiple jobs had lower satisfaction with the number of hours at their primary job suggests that multiple jobholding is not the preferred employment situation for many dental hygienists. The lack of association among those who were "dissatisfied" with work hours is likely related to a low number of individuals in this category and therefore low power to detect differences. However, although multiple jobholding hygienists may desire additional hours at their *primary job*, they do not appear to desire additional *total* hours any more than single jobholders, given that there was no difference between single and multiple jobholders in the desired total work hours relative to current total work hours. This suggests that the high rate of multiple jobholding may not necessarily be an indicator of underemployment for dental hygienists.

The high multiple jobholding rate may be related to a shortage of full-time employment

opportunities. Previously published results from this survey revealed that among dental hygienists who had been on the job market in the past five years, 58% had difficulty finding desired employment.[20] Among dental hygienists reporting job-seeking difficulty, the most common cited barrier to finding desired employment was the inability to find a full-time job (49%), followed by excessive commuting distance (34%), inadequate salary (29%) and inadequate benefits (28%). The high prevalence of difficulty finding desired employment is consistent with results from a Florida employment study, as previously discussed.[7] Given that the practice of dentistry is still dominated by small, dentist-owned private practices,[21] hiring decisions are largely made by owner dentists. The market for full-time positions in dental hygiene, along with dentist motivations for offering full- vs. part-time opportunities, warrant further study.

The potential consequences of the high rate of multiple jobholding in the dental hygiene profession include the ability of dental hygienists to access employment benefits and impacts on career satisfaction. The expected dental hygiene workforce surplus could increase multiple jobholding further if dentists are not otherwise incentivized to offer full-time positions. The growth in large group practices in dentistry could be an avenue for increased full-time opportunities given their economies of scale; however, it is not known whether employment opportunities for dental hygienists differ by practice size and structure.

An important limitation to this study is that it only included dental hygienists who worked more than one job in dental hygiene, which excludes those who may have a second job in another sector. This may result in an underestimate of the actual rate of multiple jobholding and may influence the results, as those working multiple jobs in dental hygiene may differ systematically from those working a second job in another sector. However, a specific focus of this study was to obtain an estimate of multiple jobholding within the profession, and future studies should include other-sector jobs to build on this work. Future research should also examine the desirability of multiple jobholding among dental hygienists, and the primary factors driving the high rate within this profession.

Conclusion

Consistent with national estimates, there was a high multiple jobholding rate among dental hygienists in the state of Iowa. An increased likelihood of multiple jobholding was associated with higher educational attainment, not having children in the household, being unmarried, having a shorter job tenure, and fewer number of hours at the primary job. Future studies should examine motivations for multiple jobholding among dental hygienists, as well as the job market for full-time employment opportunities.

Disclosure

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Research

Perception and Utilization of Oral Screenings and Fluoride Application in Medical Offices Following the Michigan Caries Prevention Program Training

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Abstract

Purpose: The Michigan Caries Prevention Program (MCPP) aimed to reduce the burden of childhood dental disease in the state of Michigan by offering training programs to implement preventive oral health services during well-child medical visits. The purpose of this study was to elicit feedback from the participants of the MCPP and determine which oral health services were implemented post-training, identify implementation barriers and assess provider comfort levels in performing oral screenings and fluoride applications.

Methods: A descriptive electronic survey was utilized for data collection. A 15-item survey consisting of multiple choice and Likert scale questions was sent to medical providers who had participated in the MCPP from 2015-2017 (n=1115). Descriptive statistics were used to analyze the data.

Results: A total of 170 surveys were completed for a 15% response rate. The majority of the participants were physicians (82%, n=134). Nearly all participants reported performing oral screenings and fluoride varnish application post-training (93%, n=153). Participants felt more comfortable applying fluoride varnish than performing oral screenings (80%, n=121 vs 70%, n=112), respectively. Barriers included lack of time, understaffed, staff resistance, feeling that procedures were outside of their scope of practice and disinterest from parents or safety concerns. A majority (70%, n=112) reported that the MCPP training did not help to establish new relationships with community dental providers.

Conclusion: Medical providers indicate that the MCPP training was beneficial and that they were willing and able to incorporate oral health screenings and fluoride varnish applications in their practice, but that they face challenges in developing relationships with dental care providers. Opportunities for dental hygienists to work in non-traditional medical-dental integration practice settings may help to increase oral health services offered to patients and improve communication between health care providers.

Keywords: interprofessional collaboration, Michigan Caries Prevention Program, early childhood caries, caries risk assessment, oral screening, fluoride

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Introduction

Interprofessional collaboration has been defined as the process of developing and maintaining effective interprofessional working relationships with learners, practitioners, patients, clients, families, and communities with the goal of enabling optimal health outcomes.[1] In 2000, the United States (US) Surgeon General's Report, Oral Health in America, highlighted the potential collaboration of all health care professions to improve oral health.[2] Ten years later, the World Health Organization (WHO) published the "Framework for Action on Interprofessional Education and Collaborative Practice" in order to promote interdisciplinary team-work for health care providers, as well as policy makers.[3] More recently, the US Department of Health and Human Services Health Resources and Services Administration

(HRSA) issued "Integration of Oral Health and Primary Practice" as a way to advocate for increasing oral health proficiency in primary care physicians, underscoring the need to address oral health in medical care.[4]

The Affordable Care Act (ACA) was signed into law in 2010 as a means to make healthcare coverage affordable to all. In addition to promoting affordability, the ACA has served as motivation for the implementation of interprofessional collaboration and education in health care.[5] Not only is interprofessional collaboration seen as the most efficient path to patient-centered care, it also allows patients to receive optimal health care through integrated clinical networks in an affordable manner, a primary goal of the ACA. Furthermore, the ACA has supported the medical-dental integration (MDI) model of care, with the goal of intentionally connecting these services to improve access to care.[6] This model also provides an innovative setting for dental hygienists to be employed as in-office advocates for oral health.[7] By implementing interprofessional workforce models, providers can collaborate and provide services that improve patients' overall healthcare outcomes, leading to increased levels of patient and provider satisfaction.[8,9]

Despite efforts to improve oral health for Americans, vulnerable populations, particularly low-income children, the elderly, and ethnic minorities, still face challenges accessing preventive oral health services.[9,10] Although oral health-related diseases are preventable, low-income children face multiple barriers accessing care, including affordability, shortages of dentist providers for public-insured populations, and dependence on caregivers.[10,11,12] According to the National Health and Nutrition Examination Survey (NHANES) 2009-2010 data, 14% of children aged 3-5 years had untreated dental decay.[13] Additionally, untreated dental caries was significantly higher in children aged 3-5 and 6-9 from low-income families as compared to cohorts living above the poverty level.[13] According to a 2011 Institute of Medicine report, over four million children did not receive necessary dental care because their families could not afford it.[10,14] Interprofessional collaboration with other health professionals, such as medical providers, may help to address the oral health crisis affecting these vulnerable populations.[15]

Healthy People 2020 acknowledged the lack of access to oral health care as a public health concern and identifies two areas of need specific to children and adolescents, reduce the proportion of children and adolescents with dental caries or untreated decay in their primary or permanent teeth."[16] These priorities emphasized the need for improvement in preventive oral health services for children, as well as better access to care. The American Dental Association recommends that a child's first dental visit take place at the time of the eruption of the first tooth or around six months of age 5 while the American Academy of Pediatrics, recommends that parents take their child to see a pediatrician at least six times in their first year of life.[17] When these guidances are followed, a pediatrician will see a child much more frequently than a general dentist during the first year of life.[8,17,18,19] These early pediatric visits are crucial to a child's development, and if proper oral education and caries prevention strategies are also provided, early childhood caries rates have the potential to decrease.[17,18] Pediatricians have the potential to address early childhood caries (ECC) incidence in their pediatric patients by learning how to perform oral screenings and apply fluoride varnish.[10,18]

Research indicates that pediatricians are willing and eager to provide oral health services to their patients, but challenges exist[18,19,20,21] with lack of dental insurance and/or inability to pay for care being the most common barrier.[20] Interestingly, only about a third of respondents reported lack of professional training as a barrier.[20] Lewis et al. investigated barriers primary care physicians face and found that lack of oral health knowledge was a significant barrier as well as insufficient time, space and staffing for varnish application, in addition to the belief that the procedure should remain in the scope of a dental professional. Physicians reposted experiencing difficulty referring certain groups, such as uninsured and Medicaid patients, to a dentist.[21] Additional barriers to fluoride application cited in a study by Nelson et al. included staff not agreeing to implement recommendations, limited time during patient visits, uncertain reimbursement opportunities, as well as parents opinions on the importance of oral health.[22]

The Michigan Caries Prevention Program (MCPP) was created in 2014 by the Altarum Institute, in collaboration with the University of Michigan School of Dentistry, Delta Dental Michigan, and the Michigan Department of Health and Human Services. This program aimed to reduce the burden of childhood dental disease in the state of Michigan by offering training programs to implement preventive oral health services during well-child visits.[23] The Michigan Caries Program provided training on oral health screenings, oral health risk assessments, and fluoride varnish application to primary care physician offices all over the state of Michigan who accept Medicaid, from 2015 to 2017.[23] A total of 2,783 medical providers (physicians and nurse practitioners), received training via the Smiles for Life curriculum. The MCPP utilized a multi-faceted approach which included oral hygiene services, fluoride varnish application, parent education, and dental referral.[24]

In a study conducted by Fontana et al., the intial implementaiton of the MCPP was assessed in two pilot locations by determining the barriers to adoption of services, as well as factors influencing successful outcomes.[24] The results demonstrated that participants felt more comfortable applying fluoride varnish following the training (78% compared to 54%).[24] In regards to barriers, "lack of patient/provider acceptance" was most commonly cited.[24] Additional barriers included "inadequate program monitoring and support," "lack of expertise," "time," "integrating procedure into work flow," and "reimbursement."[24] Fontana et al. found that the availability of an "oral health champion" was crucial in order to overcome barriers and long-term sustainability.[24] The role of the champion was to promote the adoption of fluoride varnish on a regular basis, and engage participants in problem-solving and quality-improvement stratgies.[24]

While some outcomes from the MCPP have been reported previously by Fontana et al., it is unclear which oral health services have been implemented post training and the impact of the program on the participants. The purpose of this study was to elicit feedback from the participants of the MCPP and determine which oral health services were implemented post-training, identify implementation barriers and assess provider comfort levels in performing oral screenings and fluoride applications.

Methods

An electronic survey was used for this study. Surveys were sent to 1,115 MCPP participants who had provided e-mail addresses to the Michigan Department of Health and Human Services at the time of the program training. The study was deemed exempt by the Health Sciences and Behavioral Sciences Institutional Review Board of the University of Michigan.

The survey was first developed in consultation with the Oral Health Director and the Early Childhood Oral Health Coordinator of the Michigan Department of Health and Human Services. The University of Michigan Survey Research Center was consulted during the survey development to establish content validity. The survey was pilot tested by two members of the Michigan Department of Health and Human Services, Division of Oral Health who were directly involved in the training program in addition to six dental hygiene educators. Survey modifications were made based on reviewer feedback.

The 15-item survey, administered by Qualtrics (Provo, UT, USA), was emailed on September 17, 2018; a reminder e-mail was sent one week later. The survey was only open for two weeks, due to time constraints. Inclusion criteria were any medical provider who had participated in the MCPP training. Survey items included participants' roles within the medical office, reasons for taking the MCPP training, knowledge of fluoride, opinions of oral health, barriers to providing services, and comfort level of providing services. All questions were multiple choice, with the exception of two Likert Scale questions. Data were analyzed with SPSS Version 25 (IBM; Armonk, NY) software and descriptive statistics were used to report results.

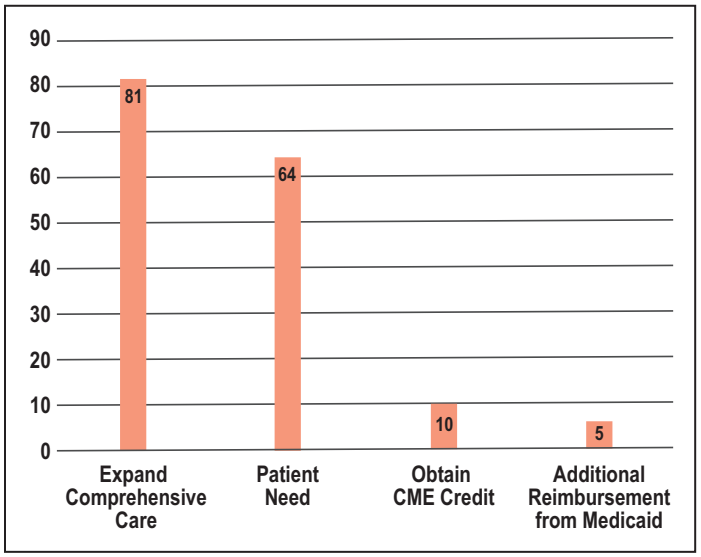
Results

A total of 170 completed surveys were returned (n=170) for a response rate of 15.24%. The majority of respondents were physicians, followed by nurse practitioners, physician assistants, nurses, and medical assistants (Table I). When asked what the primary reason was for participating in the Michigan Caries Prevention Program, over half (n=81, 51%) responded that it was to expand comprehensive care to their patients. The second most frequent response was to fulfill a patient need for oral health care (n=64, 40%). Reasons for participating in the MCPP are shown in Figure 1. Of those practices which have implemented these services, physicians were the most frequently reported person responsible for completing oral screenings (76%, n=122) and both the

Table I. Respondent demographics (n=170)

Survey item	Physician	Nurse Practitioner	Physician's Assistant	Nurse	Medical Assistant	Other
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
What is your profession?	134 (82)	15 (9)	9 (6)	3 (1)	1 (1)	1 (1)
Who is the primary member of your office responsible for providing oral screenings in the practice?	122 (76)	5 (3)	9 (6)	5 (3)	13 (8)	7 (4)
Who is the primary member of your office responsible for applying fluoride varnish in the practice?	75 (47)	3 (2)	5 (3)	13 (8)	59 (37)	5 (3)

Figure 1. Respondents' primary reason for participating in the MCPP (n=160)



physician (47%, n=75) and medical assistant (37%, n=59) were responsible for applying fluoride varnish. Participant and practice setting demographics are shown in Table I.

Prior to the MCPP training, almost three-quarters of the participants (74%, n=121) reported low levels of knowledge regarding fluoride varnish. When asked whether or not MCPP training increased general knowledge of oral health, nearly all participants provided a positive response, (95%, n=154). The vast majority of the participants had no additional oral health training upon completion of the MCPP (90%, n=147). Nearly all participants reported implementation of oral screenings and fluoride varnish services following the MCPP training (93%, n=153). Respondents who indicated that they had not implemented oral screenings and varnish applications were asked to identify barriers to implementation. Results included lack of time (33%, n=3), considered oral health care services outside of their scope of practice (22%, n=2), and "other" (44%, n=4). Written responses to "other" included, being understaffed, staff resistance, and parents not interested fluoride treatment or concerns regarding fluoride safety. Post MCPP training program outcomes are shown in Table II.

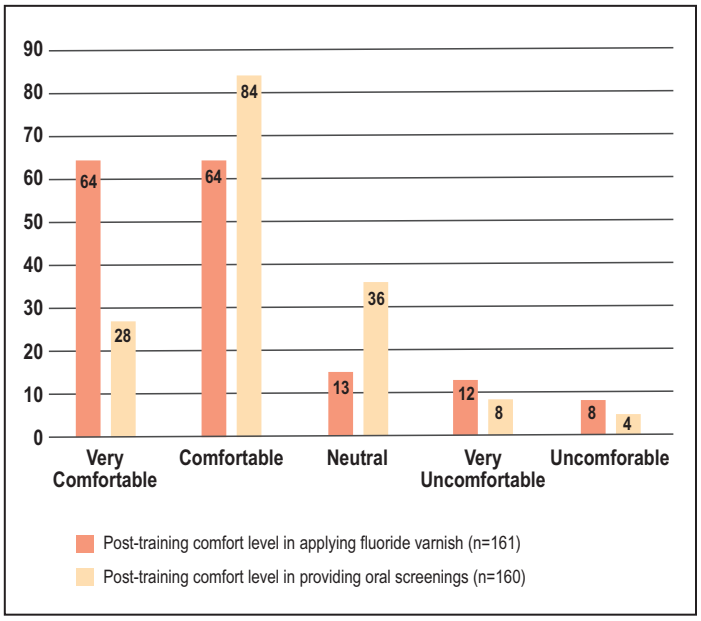
Participants were asked to rate their comfort level in applying fluoride varnish and oral screenings. More participants indicated that they were "very comfortable" (40%, n=64) applying fluoride varnish than performing an oral screening (18%, n=28) (Figure 2). Regarding caries risk assessments, well over half of the participants indicated that the training helped them improve their caries risk assessment skills (86%, n=138). However, the vast majority of participants indicated that the training did not help the office establish new relationships with the local dental community (70%, n=112) (Table II).

Table II. Post-training assessment items (n=170)*

Post-training assessment	Frequencies n (%)
Did the MCPP Program increase your understanding of oral health? (n=163)	
Yes	154 (94.5)
No	3 (1.8)
Undecided	6 (3.7)
After the MCPP training, has your office implemented the oral screening and fluoride varnish services into the practice? (n=164)	
Yes	153 (93.3)
No	11 (6.7)
After the MCPP, are you better able to assess the caries risk level of your pediatric patients? (n=160)	
Yes	138 (86.3)
No	6 (3.8)
Undecided	16 (10)
Has your MCPP training helped your practice establish new relationships with the local dental community? (n=161)	
Yes	49 (30.4)
No	112 (69.6)

* n's vary since not all of the respondents incorporated oral health programs in their settings and some response items were left blank

Figure 2. Respondents' comfort level in fluoride varnish application and oral screenings



Discussion

Low-income children suffer the consequences of access to oral health care disproportionally more than their wealthier counterparts. Results of this study demonstrated that medical providers are motivated to expand comprehensive care to their patients by integrating oral health services. These results mirror the previous findings of Quinonez et al. and Lewis et al. regarding the willingness of physicians to provide oral health services when proper training and resources have been provided.[20,21] Findings from this study are consistent Lewis et al. regarding implementation barriers including the belief that fluoride varnish application should remain within the scope of professional dental practice.[21] Despite the fact that results from this study showed that the medical providers were comfortable providing fluoride varnish, there appears to be a challenge to whether they accept this procedure as falling under their scope of practice.

Results from this study demonstrated that while most participants reported significant gains in their level of oral health knowledge, the MCPP training did not help establish new relationships with the local dental community. It should be mentioned that the MCPP did not include specific content addressing how to establish a dental home for patients; adding this content to future trainings may prove beneficial.

The majority of participants felt very comfortable with fluoride varnish applications, however fewer respondents expressed the same comfort levels towards providing oral screenings. One reason for this difference may be related to the skill levels required for the two procedures. Differentiating between normal versus deviations from normal findings during an oral screening, are second nature to a dentist or dental hygienist. This skill is developed over time and with consistent practice. It may be that the participants of this study have not had enough time to establish a solid comfort level when performing oral screenings. Also, while applying fluoride varnish may appear to be a simple procedure, there may be a false sense of confidence in these findings. Proper technique is required in order for fluoride varnish to have its maximum effects.

In a study by Quinonez et al. to determine the attitudes, practices, and barriers related to oral health of pediatricians (n=790), fewer than 10% of participants described their ability to provide fluoride varnish as "very good" or "excellent," prior to a training program.[20] However, when participants had training, more than 20% described their ability to provide fluoride varnish as "very good" or "excellent."[20] In regards to caries risk assessments, 20% described their ability as "very good" or "excellent" prior to training, as compared to 37% following oral health training.[20] While the Quinonez et al. study measured providers' pre- and post-training perceptions regarding fluoride varnish applications and caries risk assessments, a secondary finding from this study was the providers reported increased ability to assess the caries risk level of their patients.[20]

Additionally, while more than 50% of the participants felt "comfortable" completing an oral screening, it was evident that more participants felt "very comfortable" administering fluoride varnish. One reason for this disparity may be that medical providers feel that diagnosing caries is more difficult than simply applying fluoride and may be more hesitant to do so. Another reason may be that providers do not feel that diagnosing caries is within their scope of practice.

This study had limitations, including the 15% response rate. There are several reasons that may have contributed to the low response rate. One major reason may be the length of time that has elapsed since the MCPP initial training. Another possible reason may be that some of the participants were medical residents at the time of the MCPP training and were no longer associated with the e-mails provided. Another limitation to the generalizability of the findings is that the positive responses may have come from a few large medical practices that had implemented oral screenings and fluoride varnish applications following the MCPP training. Fontana et al. studied outcomes data from a sample of medical practices that had completed the MCPP training and found that medical offices with an "oral health champion" reported higher frequencies of oral screenings and varnish applications than offices without this type of team member.[24] Also, there the geographic distribution of the respondents was unknown, therefore it was not possible to track the distribution of the participants. Furthermore, MCPP training was not provided in all counties in Michigan, limiting the generalization of the results in regards to health care providers in the state.

Suggestions for future research include following-up with the MCPP providers to better understand the long-term program outcomes. Program trainers could follow-up 3-6 months post training in order ensure medical providers are able to implement the practices, assist with fluoride varnish ordering and billing, and address any questions. It would also be beneficial to introduce an "oral health champion," into these pediatric setting to advocate for the utilization of oral health services and serve as a leader towards adopting new behavioral norms.[24] Additionally, future training should emphasize establishing relationships with the local dental community for patient referrals.

An additional area requiring follow-up is evaluating which providers are receiving the MCPP training. Results of this study showed that in some cases medical assistants are applying fluoride varnish, however only physicians and nurse practitioners were part of the MCPP, suggesting that these services were delegated to other health care providers. However, it is important to remember that technique is imperative for effective fluoride varnish application. All staff members need to be trained to ensure that the services provided are effective. There may also be opportunities for dental hygienists to play supporting roles in the education and training of medical providers.

Conclusion

The MCPP had a positive impact on increasing preventive oral health services in the pediatric population in Michigan. Program participants felt comfortable with fluoride varnish applications, however they were less comfortable performing oral screenings following the MCPP training. While participants felt indicated increased understanding of oral health and comfort in providing oral health care services, there was still a lack of communication between medical and dental providers. Strategies to be considered in the future include emphasizing interprofessional collaboration and communication between medical and dental providers, establishing oral health advocates into medical office settings and long-term program outcome evaluations. Dental hygienists can play integral roles supporting improved patient outcomes in interprofessional collaborations with medical providers.

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Research

Associations of Self-Reported Oral Health Quality of Life with Actual Oral Health Status in Children

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Abstract

Purpose: Quality of life is considered a component of patient centered care. The purpose of this study was to examine the relationship between self-reported oral health related quality of life (OHRQoL) and the actual oral health status of children.

Methods: This retrospective cohort study consisted of pediatric dental chart reviews from three clinics. Demographic and dental visit data along with the child's OHRQoL utilizing the Pediatric Oral health-related Quality of Life (POQL) instrument, were collected. Associations with untreated decay, treated decay, or POQL score were tested, using Chi-square, Fisher's exact test, 2-sample t-tests, or ANOVA. Linear regression was used to evaluate the effect of statistical confounders in the relationship between untreated decay and POQL scores. Significance level was set to 0.05.

Results: Two hundred ninety-seven out of 336 children had both POQL and caries data. White children and children with untreated decay had significantly more negative POQL scores. Children rating their oral health as "excellent" or "very good" and children with sealants on molars had significantly more positive POQLs. Associations between POQL scores were significant with untreated decay, but not sealants, when considering both variables in the same model. After adjusting for having sealants, POQL scores were on average 7.5 points higher (more negative) in children with untreated decay, than in children without decay ($p<0.001$).

Conclusions: Collecting OHRQoL data allows oral health providers to easily incorporate patient perceptions in their assessment and care and would ensure that all oral health needs of the patients are being met. This is important for children, who may have difficulty expressing their concerns, particularly in clinical environments.

Keywords: health-related quality of life, pediatric health; oral health, person-centered care, dental caries

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Introduction

Health care providers have traditionally been taught to use a "medical model" when treating patients. This model treats the person and their social difficulties as medical problems and does not consider any social determinants of health.[1,2] The literature has revealed that this medical model is not optimal due to its restrictions on the individual's self-identity.[3] Emergent trends in contemporary health care challenge providers to focus on the individual's "strengths, interests, positive functions, needs, and characteristics" rather than their disease.[4,5] This trend, "personhood," is considered a vital element for developing patient rapport and trust.

There is an abundance of evidence to support the concept that engaging people in their own health is a fundamental aspect of providing high-quality health care.[6–8] For many decades, the World Health Organization has acknowledged that health goes beyond physical attributes and that an individual's quality of life should be considered as a component of patient care.[9] This concept was more recently emphasized in Healthy People 2020 when the United States (US) Surgeon General incorporated quality of life into its measures. A goal was included to promote "quality of life, healthy development, and health behaviors across all life stages."[10] More importantly, health care providers must also be aware that one's quality of life is determined by the patient, and not the provider.[11]

The need to consider quality of life is not exclusive to medical providers. This concept is also essential in dentistry. The American Dental Education Association Commission on Change and Innovation in Dental Education (ADEA CCI) 2.0 is a group of dental education stakeholders concerned with establishing oral health education and practice strategies that are responsive, practical, and collaborative. One of the three goals targeted by the ADEA CCI 2.0 in 2017, was person-centered health care.[12] It has been asserted that person-centered health care will become the dominant model of health care delivery in the future and members of the ADEA CCI 2.0 have been establishing innovative ways to prepare the dental workforce for this change.[13]

One practical method to integrate person-centered care into practice is by including oral-health related quality of life questions (OHRQoL) into patient assessments. These questions are based on the assertion that an acceptable level of oral health, comfort, and function is essential to a person's overall health.[14] Oral-health related quality of life has been defined as a "multidimensional construct that reflects, among other things, an individual's comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health."[15]

The University of Missouri – Kansas City Oral Health-Related Quality of Life (UMKC OHRQL) theoretical model, a conceptual model designed to be a foundation for "assessing, planning, implementing, and evaluating" OHRQoL outcomes, was developed in 1998 by Williams et al.[16] This model was designed to provide dental hygienists with a framework for developing the current person-centered care environment.[16,17] Darby and Walsh discussed the importance of OHRQoL when developing the human needs conceptual model (HNM) for dental hygiene practice.[17] While acknowledging OHRQoL in the 1993 publication,[17] the most recent version of the HNM incorporates eight human needs into the dental hygiene process of care,[18] but does not explicitly capture OHRQoL outcomes in the same way as the UMKC OHRQL theoretical model.[15] The UMKC OHRQL model requires examination of specific characteristics of the individual including, sociocultural influences, environmental influences, and economic influences,[15] thereby capturing the biopsychosocial measures in the assessment process for consideration in the dental hygiene process of care.[18] The UMKC OHRQL model was one of several models studied by Brondani and MacEntree.[19] In their findings, Brondani and MacEntree acknowledge the UMKC OHRQL model as being one of a few OHRQoL models to illustrate a change in the understanding of oral health to being about more than just illness.[19] Yet, a recent study exploring how the UMKC OHRQL model is being applied in education, research, and practice, found that the collection and use of quality of oral health data has been minimal in all three settings.[20] While the foundation has been laid for oral health care practitioners to embrace the person-centered care model, it will take greater effort to bring the education and practice community onboard. For the remainder of this paper, OHRQoL will refer to what is known in the literature as oral health-related quality of life.

The literature on OHRQoL as it applies to adult populations has existed for several decades, however, research on OHRQoL in children has been limited. A variety of instruments for capturing OHRQoL in children have been developed in recent years.[21–25] The Pediatric Oral health-related Quality of Life (POQL) instrument was developed by a team of researchers from Boston University, with an emphasis on capturing experiences and views of children and has been shown to be valid and reliable as a measure of OHRQoL in children.[26] A study by Gadbury-Amyot et al. revealed that asking OHRQoL questions of children could be integrated into the process of care with minimal disruption and time.[27] The investigators found that asking OHRQoL questions of children using the POQL instrument only added an average of 6 minutes to the appointment. Additionally, oral healthcare workers noted that having the OHRQoL information directly from the child, provided greater insight about the child and their oral health.

The POQL has been validated across a wide variety of populations.[26,28–30] However, Huntington et al. evaluated the POQL in children from a general, metropolitan population in the US, not limited to a specific race/ethnic group, in order to validate the instrument.[26] Further studies are needed to demonstrate that the POQL score is a good indicator for a child's actual oral health in general populations across the US. The purpose of this study was to examine the relationship between demographics, health perceptions, dental characteristics, and self-reported OHRQoL with actual oral health status for children.

Methods

This retrospective cohort study was approved by the University of Missouri-Kansas City Institutional Review Board (#17-040).

Sample population

A mobile school-based dental program in Kansas, a fixed school-located dental program in Missouri, and a fixed safety net dental clinic in Missouri, participated in this study. All three programs were associated with community health

centers and were each unique in the way they delivered oral health care services to children. One program employed dental hygienists to deliver oral health care in schools using portable equipment for the delivery of care. Another program employed a more traditional mix of dental workforce personnel where they delivered oral health care services in fixed school-located dental clinics. The third program conducted screenings in schools, but the actual delivery of care was provided by dentists and dental hygienists in two safety-net dental clinics in the community.

Survey instrument

All three participating programs agreed to integrate a short survey containing the POQL instrument into their standard process of care; hereafter, referred to as the Child Self-Report POQL. Dental hygienists administered the survey by verbally asking children the POQL questions and documenting their answers on a paper copy of the instrument. The survey instrument contained six standalone questions, three on child's self-reported health and oral health perceptions and three on the child's self-reported dental history, in addition to the ten original POQL items. The ten POQL questions, which were used to generate the POQL score, elicited concerns that the child had regarding their oral health in the last three months and the frequency and severity of those concerns. of those concerns. The survey instrument is shown in Table I.

Table I. Child self-report POQL instrument questions

How would you rate your health in general?
In general, how would you rate the health of your ***teeth and mouth***?
Compared to one year ago, how would you describe the health of your teeth and mouth ***now***?
In the past 3 months…
1. Did you have pain because of your teeth or mouth?
2. Did you have trouble eating any foods (hard/hot/cold) because of your teeth or mouth?
2. Did you have trouble paying attention in school because of your teeth or mouth?
4. Did you miss school because of your teeth or mouth?
5. Did you not want to laugh or smile around others because of your teeth or mouth?
6. Did you worry that you were not good looking to others because of your teeth or mouth?
7. Were you unhappy with the way you looked because of your teeth or mouth?
8. Were you angry or upset because of your teeth or mouth?
9. Did you feel worried because of your teeth or mouth?
10. Did you cry because of your teeth or mouth?
In general, how would you describe your experiences with your dentist?
When was your last visit to a dentist?
What was the reason(s) for your last dental visit? ***Please select all that apply.***

Data collection

Each clinic generated a list of children who had received dental care at specified school-based dental clinics during a three-month window of time. A retrospective chart review was performed for each child on the list. Data was abstracted from the child's electronic health record including patient record number, demographic data (age at last visit, gender, race, ethnicity, and insurance status), dental visit data (visit date, number of primary and permanent teeth present, number of teeth with treated and untreated decay, number of permanent molars eligible for and having sealants), and Child Self-Report POQL results. Abstracted data was entered into REDCap (Research Electronic Data Capture; http://project-redcap.org/) and subsequently downloaded into Stata 15.1 (Stata Corp; College Station, TX, USA College Station, TX, USA). All data was abstracted from the child's most recent visit that contained all the dental data of interest and Child Self-Report POQL.

Statistical analysis

The POQL score was calculated from the ten original questions only, according to instructions obtained from the authors of the POQL instrument. Scores could range from 0 (most positive OHRQoL rating) to 100 (most negative OHRQoL rating). Additional standalone questions on child self-reported health and oral health perceptions within the Child Self-Report POQL were dichotomized. Child rated health in general and rated oral health in general were collapsed to "excellent" or "very good" versus "good", "fair", or "poor." The Child rating of their oral health at present day compared to one year ago was dichotomized to "much better" or "somewhat better" versus "about the same", "somewhat worse", or "much worse".

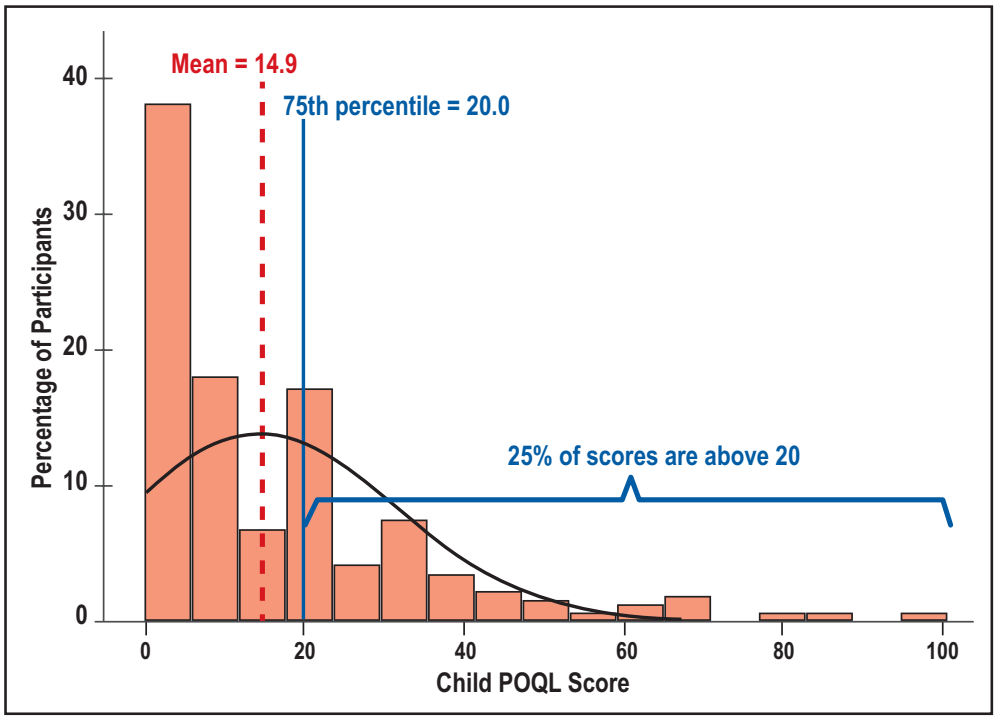
Descriptive statistics were calculated for all variables of interest. Associations between child characteristics and untreated or treated decay was evaluated using Chi-square or Fisher's exact tests. Two-sample t-tests with unequal variances, ANOVA, or Welch's ANOVA were used to test associations between the child characteristics and POQL score. To ensure that difference in the location (the state in which the clinics

were located) did not impact the relationship between oral health variables of interest and child POQL scores, a test to determine whether the specific state of location was an effect modifier of those relationships was performed using linear regression with robust standard errors. No effect modification of those relationships was found. Multivariable linear regression models with robust standard errors were also used to evaluate the association between child POQL scores and any significant dental variables after adjusting for any variables found to be statistical confounders (significantly associated with both predictor and outcome). The significance level was set to 0.05.

Results

Data was obtained from the dental records of 315 children, between the ages of 8 to 14, who had complete POQL score data. Participants had an average POQL score of 14.9 (± 17.1) where 0 (most positive) was the minimum and 100 (most negative) was the maximum value scored. However, most of the participants had a POQL score of 20 or less (75%) and only 25% of the participants had a POQL score greater than 20 (more negative). The distribution of the POQL scores of the sample are shown in Figure 1. Of the 315 participants with POQL scores, 94% (n=297) had complete caries data charted; 45% (n=134) had untreated decay and 62% (n=184) had treated decay.

Figure 1. Distribution of child POQL score with a normal density curve showing the Mean and 75th Percentile of the POQL scores overlay.



Demographics

The majority of the children were between 9 and 12 years old (62%, n=183), female (52%, n=155), identified as White race (61%, n=181), and had Medicaid insurance (71%, n=211). Age was not significantly associated with untreated or treated decay nor was it associated with the child's POQL score. Gender and Hispanic ethnicity were both significantly associated with untreated decay. Males were significantly more likely to have untreated decay than females (52%, n=74 vs 39%, n=60) ($p=0.020$). Hispanics were significantly more likely to have untreated decay than non-Hispanics (59%, n=71 vs 36%, n=25) ($p=0.002$). Of the child demographic variables, only insurance status was significantly associated with treated decay. Children with Medicaid insurance were significantly more likely to have treated decay than children with private or no insurance (71%, n=149 vs 62%, n=13 and 33%, n=18 respectively) ($p<0.001$). Race was the only demographic variable associated with child's POQL score. White children had significantly more negative mean POQL scores compared to children from other races (16.8 vs 11.5) ($p=0.019$). Associations between decay and demographic characteristics are shown in Table II.

Child health perceptions

About half of the children rated their health in general as "excellent" or "very good" (54%, n=160). In contrast, only 37% (n=110) of the children rated their oral health in general as "excellent" or "very good". Additionally, when asked the question, "Compared to one year ago, how would you describe the health of your teeth or mouth now?", half of the children (50%, n=147) reported "about the same", "somewhat worse", or "much worse." Oral health ratings were significantly associated with whether the child had untreated decay and with the child's POQL score. Children who had rated their oral health as "excellent" or "very good," in general, were significantly less likely to have untreated decay (29%, n=32 vs 54%, n=98) ($p<0.001$)

Table II. Decay and POQL scores associations with demographic characteristics (n=297)

	Entire Sample	Untreated decay*			Treated decay*			POQL score*	
		No n=163	Yes n=134	*p*-value†	No n=111	Yes n=184	*p*-value†	Mean (SD)	*p*-value‡
	n (%)	n (%)	n (%)		n (%)	n (%)			
Age (years)				**0.378**			**0.374**		**0.106¶**
8	78 (26.3)	38 (48.7)	40 (51.3)		34 (44.2)	43 (55.8)		12.3 (15.1)	
9-12	183 (61.6)	106 (57.9)	77 (42.1)		65 (35.7)	117 (64.3)		15.1 (17.8)	
13-14	36 (12.1)	19 (52.8)	17 (47.2)		12 (33.3)	24 (66.7)		19.3 (16.8)	
Gender				**0.020**			**0.424**		**0.094**
Male	142 (47.8)	68 (47.9)	74 (52.1)		56 (40.0)	84 (60.0)		13.2 (16.0)	
Female	155 (52.2)	95 (61.3)	60 (38.7)		55 (35.5)	100 (64.5)		16.4 (17.9)	
Race				**0.485**			**0.719**		**0.019**
White Race	181 (60.9)	89 (49.2)	92 (50.8)		70 (39.1)	109 (60.9)		16.8 (18.3)	
Other	55 (18.5)	30 (54.5)	25 (45.5)		23 (41.8)	32 (58.2)		11.5 (13.9)	
Missing	61 (20.5)	44 (72.1)	17 (27.9)		18 (29.5)	43 (70.5)		—	
Ethnicity				**0.002**			**0.079**		**0.137**
Not Hispanic	70 (23.6)	45 (64.3%)	25 (35.7)		21 (30.0)	49 (70.0%)		13.4 (15.8)	
Hispanic	121 (40.7)	50 (41.3)	71 (58.7)		51 (42.9)	68 (57.1)		17.1 (18.1)	
Missing	106 (35.7)	68 (64.2)	38 (35.8)		39 (36.8)	67 (63.2)		—	
Insurance				**0.298§**			**<0.001**		**0.083•**
Medicaid	211 (71.0	117 (55.5)	94 (44.5)		61 (29.0)	149 (71.0)		15.0 (16.4)	
Private	22 (7.4	15 (68.2)	7 (31.8)		8 (38.1)	13 (61.9)		9.5 (12.7)	
None	54 (18.2)	25 (46.3)	29 (53.7)		36 (66.7)	18 (33.3)		15.8 (17.7)	
Other	5 (1.7)	2 (40.0)	3 (60.0)		3 (60.0)	2 (40.0)		39.8 (37.5)	
Missing	5 (1.7)	4 (80.0)	1 (20.0)		3 (60.0)	2 (40.0)		—	

*Missing data (including missing caries data) were excluded from tests of associations.

†Chi-square tests except where otherwise indicated; ‡2 sample t-tests (unequal variance) except where otherwise indicated

¶Oneway ANOVA; §Fisher's exact tests; •Welch's ANOVA

and had significantly more positive mean POQL scores (10.5 vs 17.5) ($p<0.001$) than those who rated their oral health as "good", "fair", or "poor." Participants who described their oral health now compared to one year ago as "much better" or "somewhat better" were significantly more likely to have treated decay than children who said it was "about the same", "somewhat worse", or "much worse" (70%, n=98 vs 55%, n=80) ($p=0.008$) Associations of the POQL scores with child health perceptions and dental characteristics and conditions are shown in Table III.

Dental characteristics

At their most recent dental visit, most of the participants had sealants on molars (70%, n=207). Having sealants placed on molars was significantly associated with untreated decay and child's POQL score. A child with sealants placed on molars was significantly less likely to have untreated decay (36%, n=75 vs 65%, n=57) ($p<0.001$) and had significantly more positive mean POQL scores (13.2 vs 17.8) ($p=0.037$) than a child with no sealants placed on molar teeth. Children with untreated decay had significantly more negative mean

Table III. Untreated or treated decay and POQL score associations

	Entire Sample	Untreated Decay*			Treated Decay*			Child POQL Score*	
	n = 297	No n = 163	Yes n = 134	*p*-value†	No n = 111	Yes n = 184	*p*-value†	Mean (SD)	*p*-value‡
	n (%)	n (%)	n (%)		n (%)	n (%)			
General health rating				**0.284**			**0.118**		**0.633**
Excellent or Very Good	160 (53.9)	84 (52.5)	76 (47.5)		66 (41.8)	92 (58.2)		14.3 (17.3)	
Good, Fair, or Poor	131 (44.1)	77 (58.8)	54 (41.2)		43 (32.8)	88 (67.2)		15.3 (16.8)	
Missing	6 (2.0)	2 (33.3)	4 (66.7)		2 (33.3)	4 (66.7)		—	
Rated health of mouth or teeth				**<0.001**			**0.074**		**<0.001**
Excellent or Very Good	110 (37.0)	78 (70.9)	32 (29.1)		48 (44.0)	61 (56.0)		10.5 (14.1)	
Good, Fair, or Poor	180 (60.6)	82 (45.6)	98 (54.4)		60 (33.5)	119 (66.5)		17.5 (18.2)	
Missing	7 (2.4)	3 (42.9)	4 (57.1)		3 (42.9)	4 (57.1)		—	
Described health of teeth and mouth compared to 1 year ago				**0.144**			**0.008**		**0.535**
Much better or Somewhat better	141 (47.5)	84 (59.6)	57 (40.4)		42 (30.0)	98 (70.0)		15.1 (17.3)	
About the same, Somewhat worse, or Much worse	147 (49.5)	75 (51.0)	72 (49.0)		66 (45.2)	80 (54.8)		13.9 (16.5)	
Missing	9 (3.0)	4 (44.4)	5 (55.6)		3 (33.3)	6 (66.7)		—	
Sealants placed on molar teeth				**<0.001**			**0.199**		**0.037**
No	88 (29.6)	31 (35.2)	57 (64.8)		31 (35.2)	57 (64.8)		17.8 (17.5)	
Yes	207 (69.7)	132 (63.8)	75 (36.2)		132 (63.8)	75 (36.2)		13.2 (16.3)	
Missing	2 (0.7)	0 (0.0)	2 (100.0)		0 (0.0)	2 (100.0)		—	

*Missing data (including missing caries experience data) were excluded from tests of associations.

†Chi-square tests; ‡2 sample t-tests (unequal variance)

POQL scores (18.8 vs 11.0) ($p<0.001$). Associations between untreated and treated decay with POQL scores are shown in Figure 2.

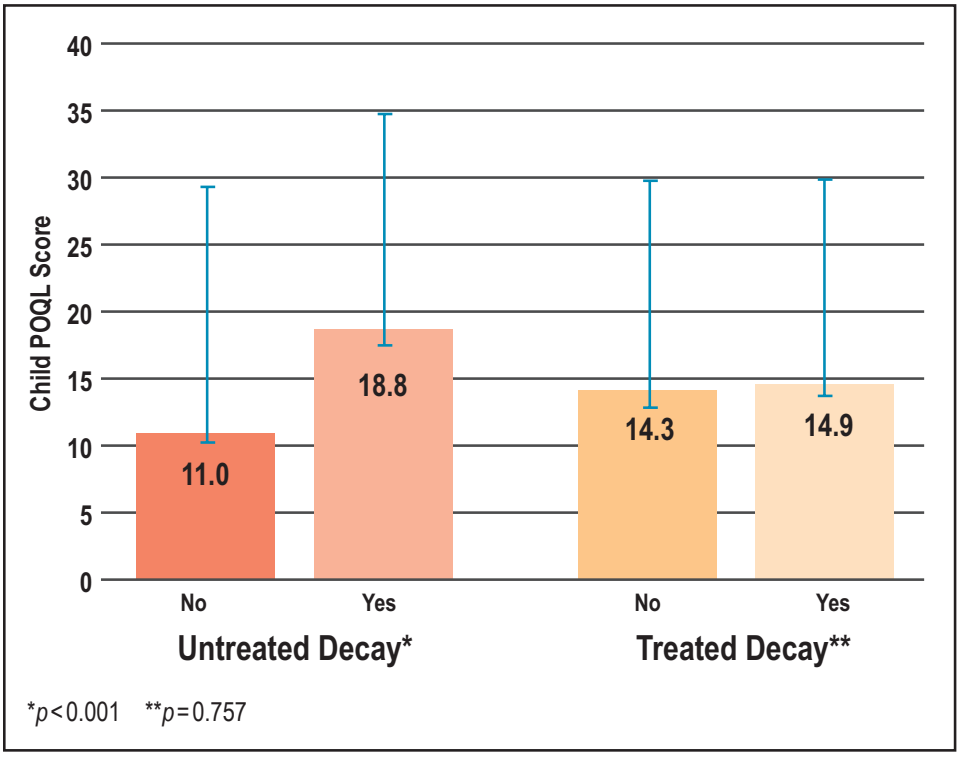
Adjusted associations with POQL scores

Having sealants on molar teeth and childrens' perceptions of their oral health were confounders for the association between untreated decay and POQL scores. Therefore, the association between untreated decay and POQL scores was evaluated after adjusting for these variables. The association between untreated decay and POQL scores remained significant in a model adjusting for sealants on molars (slope=7.23, $p<0.001$), in a model adjusting for child's rating of their oral health (slope=6.12, $p=0.002$), and in a model adjusting for both (slope=5.53, $p=0.008$). Child's rating of their oral health was significant after adjusting for untreated decay (slope=-5.34, $p=0.005$) and after adjusting for both untreated decay and sealants on molars (slope=-5.54, $p=0.004$). However, having sealants on molars was no longer associated with POQL scores in any adjusted model (Table IV).

Discussion

A strong association was found between a child's self-reported oral health quality of life measure and their actual oral health. Children with untreated decay had more negative POQL scores than children with no untreated decay, similar to the Huntington et al. findings from the POQL instrument validation study. Huntington et al. examined over 3,000 children during a 3-year time period from different schools and dental clinics across a metropolitan area.[26] Children with caries, defined as active, untreated decay or any other current

Figure 2: Associations between untreated and treated decay with POQL score evaluated with 2 sample t-tests with unequal variances.



dental need requiring immediate treatment, had significantly higher POQL scores than children who were caries free (9.4 vs 6.4) ($p=0.003$). In this sample of children (n=297), an average POQL for children with and without untreated decay was found to be nearly twice that of Huntington et al. This is most likely due to the differences in regions where the children were living, the Northeast versus the Midwest, and to the much larger sample size of the Huntington et al. study.[26] However, even in studies of Native American Indian children, who have been found to have a high caries rate, caregiver reported POQL scores were significantly higher in children having early childhood caries[29] or with higher utilization rates of urgent dental services during the past year.[31] Notably, the POQL scores were not associated with treated decay, indicating that this particular OHRQoL instrument is sensitive to current oral health concerns and not dental treatment that had occurred in the past.

Results from this study revealed a significantly more positive POQL score in children with sealants placed on molar teeth than children without sealants. Dental sealants have been shown to prevent more than 80% of cavities in the posterior teeth, where the majority of cavities occur[32–34] and it is not surprising that children with sealants placed on molar teeth had a more positive oral health quality of life than the children with without sealants. However, using a model that evaluated the associations of POQL scores with both untreated decay and molar sealants together, only the untreated decay was found to be significantly associated with POQL scores. It appears that the relationship between sealant placement and the POQL score was confounded by the child's current level of untreated decay, suggesting that the OHRQoL in this sample was primarily driven by the child's current decay status.

Children with Medicaid or private dental insurance in this study had significantly higher rates of treated decay than children without any dental insurance. This may be due to the fact that children with dental insurance coverage are more likely to have treatment performed when needed, than children without insurance coverage.[35] White children reported significantly more negative OHRQoL than nonwhite children in this study. It is unclear why this result was found. Future studies should further explore this difference.

Children's perceptions of their oral health were strongly associated with untreated decay in this study. Children who rated their oral health as "excellent" or "very good" had significantly lower rates of untreated decay than children who rated their oral health as "good", "fair", or "poor". Results from this study demonstrate that the patient's perception of their present oral health was captured by the POQL instrument.

The Child Self-report POQL instrument shows promise in facilitating person-centered oral health care. The only cost is the minimal amount of time it takes to administer the instrument. Baseline knowledge of a child's concerns with their oral health can be easily and effectively elicited with the use of this instrument. Follow-up by the oral health care provider on issues that are brought up by the child can aid in improving the child's overall oral health and oral health quality of life. Oral health providers have reported that the POQL questions help to elicit valuable information, such as a child being bullied because of how their teeth looked, that they would not have otherwise known.[27] Traditionally, dental providers in community health settings have not collected quality of life data from the patients during their visits. Oral health care providers should consider integrating OHRQoL instruments as key components of person-centered care, to help ensure that they are able to understand the oral health concerns of their patients, especially children.

Table IV. Associations with Child POQL scores* after Adjustment for Confounding using Linear Regression with Robust Standard Errors.

	POQL Score								
	Adjusted Model 1			Adjusted Model 2			Adjusted Model 3		
	Mean Difference	95% CI**	*p*-value	Mean Difference	95% CI**	*p*-value	Mean Difference	95% CI**	*p*-value
Untreated decay			**<0.001**			**0.002**			**0.008**
No	reference			reference			reference		
Yes	7.23	(3.33, 11.14)		6.12	(2.31, 9.93)		5.53	(1.47, 9.58)	
Sealants on molar teeth			**0.232**			**--**			**0.133**
No	reference			--	--		reference		
Yes	-2.64	(-6.97, 1.7)		--	--		-3.32	(-7.66, 1.01)	
Rated health of mouth or teeth			**--**			**0.005**			**0.004**
Good, Fair, or Poor	--	--		reference			reference		
Excellent or Very Good	--	--		-5.34	(-9.05, -1.63)		-5.54	(-9.3, -1.77)	

* Adjusted for confounding using linear regression with robust standard errors.

**CI = Confidence Interval

Implications of findings and limitations

This study highlights the benefits of utilizing OHRQoL as part of data collection in a person-centered healthcare environment, where patient perceptions play a critical role in their overall assessment and care. It is particularly important to ensure that the oral health care being provided to pediatric patients considers the oral health factors that are important to the individual child.

This study had several limitations. This study was limited to convenience data from three types of dental clinics located in two states, limiting the generalizability of the results. Furthermore, neither the clinics nor the sample population were randomized for enrollment and unmeasured factors could confound associations in the sample. Additionally, each participant's dental data and the POQL results were taken from the same dental visit. Hence, any causality of the association between POQL scores and dental data would be hard to infer. Future studies should include a larger sample population across multiple states. An important next step in this research would be to conduct a prospective cohort study to evaluate a child's OHRQoL at the initial baseline visit and evaluate whether the OHRQoL is a predictor for future dental needs.

Conclusion

Higher rates of untreated decay were associated with a more negative OHRQoL in pediatric patients. Oral health care providers should be encouraged to move to a more person-centered care model, where data such as oral health quality of life are collected and factored into patient care. Use of an OHRQoL assessment tool for evaluating a child's oral health quality of life is strongly associated with their actual dental health and can be a powerful aid in understanding the oral health perceptions and needs of pediatric patients.

Disclosure

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The Prevalence of Burnout Among Entry-Level Dental Hygiene Program Directors

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Abstract

Purpose: Workplace burnout in academia is a problem that affects career satisfaction and longevity. The purpose of this study was to determine the prevalence of burnout among entry-level dental hygiene program directors.

Methods: The Copenhagen Burnout Inventory (CBI) survey was used to determine prevalence of burnout in 325 dental hygiene program directors from across the United States. The survey was disseminated electronically. The CBI contains 19 questions that measure overall, personal, work-related, and client/student-related burnout on a five-point Likert type scale. The survey also included nine demographic and three open-ended questions related to burnout. Descriptive statistics, one sample t-tests, and one-way ANOVA tests were used to analyze the data.

Results: One hundred twenty-seven dental hygiene program directors completed the survey for a 39.1% response rate. Most participants (62.2%, n=79) indicated moderate to high burnout on the personal burnout subscale, approximately one half (51.2%, n=65) on the work-related burnout subscale, and one third (33.1%, n=42) on the client/student-related burnout subscale. No statistically significant differences were found when comparing mean scores between directors of two-year and four-year program or between participants under age 50 and those 50 years of age and older (p-values>0.05). Program directors with teaching workloads of 51-60% had significantly lower burnout on the work-related burnout subscale when compared to participants with teaching workloads of 31-40% (p=0.045). Participants with the lowest workload allocations for administrative duties had higher overall mean burnout scores.

Conclusion: Results from this study suggest one out of two dental hygiene program directors have symptoms of some type of burnout with the highest prevalence rate in the personal burnout subscale. Findings underscore the need for further research to identify stressors that lead to burnout as well as identify prevention strategies that promote a healthier work climate for dental hygiene program administrators.

Keywords: burnout, dental hygiene education, dental hygiene educators, career longevity, professional development

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Introduction

Workplace burnout is a major psychosocial problem associated with job negativity, decreased work efficiency, and adverse health effects.[1-4] Defined as a prolonged response to chronic emotional and interpersonal work stressors, burnout is associated with feelings of emotional exhaustion, increased job negativity, and reduced personal accomplishment.[1-3] While depression and burnout share similar traits, burnout involves only work stressors while depression involves both work-related and personal life stressors and issues.[1,4] Burnout is fostered by unsuccessful attempts to cope with workplace stress over time.[3,4] It has been reported as a frequent occurrence in many service-related professions throughout the world and research suggests high prevalence rates in both teachers and health care providers.[5-15]

The World Health Organization (WHO) describes burnout as an occupational syndrome, rather than a medical condition, that occurs when poorly managed workplace stress becomes a chronic condition.[16] Others have described burnout as a disharmony between the individual and the work environment leading to both physical and mental health issues.[10-13] Clinical

manifestations of burnout include headaches, GI problems, sleep disturbances, eating disorders, and muscle aches [11,16] Psychosocial issues include workplace fear, anxiety, cynicism, lack of motivation, disillusionment, decreased self-efficacy, energy depletion, and impaired job performance; these psychosocial impacts have also been connected to substance abuse issues.[12,16] Burnout in health care professionals has been linked to patient safety issues, increased health care costs, and workforce well-being.[17-20] Moreover, increased medical errors and poorer patient outcomes have been linked to professional burnout.[17-21] For example, Shanafelt et al. found physicians with high levels of burnout reported three times the number of medical errors as compared to non-burnout physicians.[21]

Program administrators of academic departments may be particularly prone to burnout.[22] Being responsible for day-to-day program operations, overseeing and hiring faculty, budget concerns, accreditation, increasing teaching workloads, service requirements, and in some cases scholarly activities and research, are all important administrative functions leading to stress and possible burnout. Research suggests a high correlation between program director turn over and burnout.[22-24] O'Connor et al. found one third of medical residency program directors experienced burnout and half considered resigning in the preceding year of the study; in just four years, 50% of medical residency program directors had changed nationally.[22]

In health care programs, changing of program directors is costly, may negatively impact program stability, and affects faculty, patients, and students.[22-23] Moreover, research suggests burnout affects the longevity and quality of academic careers, and female directors tend to experience higher levels of burnout than their male counterparts.[22-25] For example, Walter et al. found women program directors of athletic training education programs had significantly greater emotional exhaustion levels than men, although tenure-track program directors had higher emotional exhaustion scores than tenured directors, regardless of gender.[26] Windover et al. also found burn-out among program directors was strongly associated with work-home conflicts, more commonly reported among female program directors than males.[3]

There is a gap in the literature related to burnout in dental hygiene program administrators and whether they are affected by workplace burnout. However, several studies have researched levels of burnout among academic program directors.[22-25] Porter et al. surveyed family medicine program directors with nearly one third reporting high emotional exhaustion burnout scores.[24] Similarly, De Oliveria et al. found that 52% of anesthesiology program directors were at high risk for developing burnout.[23,24] Only one study could be found on burnout involving dental hygiene program directors, with 43% of the participants (n=20) reporting moderate to high emotional exhaustion burnout levels.[27] More research is needed to identify whether dental hygiene program directors are affected by burnout, especially since leadership burnout may not only negatively affect the individual, but also the academic unit in its entirety. The purpose of this study was to address this gap in the literature by determining the prevalence of burnout among entry-level dental hygiene program directors; additionally, this study aimed to identify differences in burnout among two-year and four-year program directors and workload status of participants.

Methods

A descriptive survey design was used to collect data regarding the level of burnout experienced by dental hygiene program directors. This study was determined to be exempt by the Old Dominion University College of Health Sciences Institutional Review Board Committee. The 19-item Copenhagen Burnout Inventory (CBI), a valid and reliable measuring instrument, was emailed to 325 dental hygiene program directors of entry-level dental hygiene programs, as reported by the American Dental Hygienist Association.[28] Data was collected via three electronic mailings over 6 weeks using Qualtrics (Provo, UT, USA).

At the beginning of the survey, an introductory statement was provided informing participants that participation was voluntary, responses would remain anonymous, and they would be reported in group form only. Voluntary informed consent was understood upon return of the survey. The CBI is divided into three subcategories: personal burnout, work-related burnout, and client-related burnout. In each subcategory, the degree of physical and psychological fatigue and exhaustion is measured as perceived by the individual, that which is related to work, and that which is related to clients/students.[28]

The CBI includes six items measuring personal burnout, seven items measuring work-related burnout, and six items related to client/student-related burnout.[28] Questions are measured on a five-point Likert type scale with some questions assessed by intensity (very low to very high) and others by frequency (never to always). Scoring ranged from 0 to 100, with scores of 1-49 indicating low burnout, 50-74 indicating moderate burnout, 75-99 indicating high burnout, and a score of 100 indicating severe burnout. The survey also consisted of nine questions related to gender, age, academic rank, and program demographics; additionally, two open-ended questions related to personal and professional factors contributing to stress and burnout status, a question

regarding leaving an administrative position due to stress, and three questions related to workload. A panel of dental hygiene faculty reviewed the additional questions in the survey outside of the CBI to establish content validity and to test clarity of instructions. Modifications to the survey instrument were made based on the panel's review.

Descriptive statistics were calculated for overall CBI scores and each subcategory to determine burnout prevalence. Open-ended questions were transcribed and qualitatively analyzed. Responses were coded based on reported personal and professional stressors. All coding was reviewed by a colleague prior to frequency analysis to establish content reliability. Differences in response frequency issues were discussed, and calibration in responses was achieved. Additionally, independent samples t-tests were utilized to compare entry-level program directors at two-year and four-year institutions on burnout levels, as well as those under 50 years old to those 50 or older. Finally, a one-way, between-subjects ANOVA test was utilized to compare various workload subgroups of participants on burnout levels.

Results

Of the 325 program directors invited to participate in the online survey, 127 completed the survey for a response rate of 39.1% (n=127). The majority of participants were female (94.5%), Caucasian (89.76%), and 50 years of age or older (72%). Over three quarters of the respondents held a master's degree (77%, n=98), while 19% (n=24) held doctoral degrees; five respondents (4%) indicated a baccalaureate degree as their highest level of education. Over two-thirds (67%, n=85) were employed at two-year technical or community college programs while the remainder (33%, n=42) were employed at four-year programs. Demographic characteristics are shown in Table I.

Results revealed the total average overall burnout score for participants was 46.03, indicating overall low burnout. However, the majority of participants (62.2%, n=79) had scores indicating moderate to high burnout on the personal burnout subscale, with a little more than one third with scores indicating low burnout (37.8%, n=48). On the work-related burnout subscale, approximately one half of the participants (51.2%, n=65) had scores indicating moderate to severe burnout. Data on the client/student-related burnout subscale indicated approximately one third of participants had scores indicating moderate to high burnout (33.1%, n=42). Mean CBI subscale scores for participants were 54.07 (moderate) on personal burnout, 46.79 (low) on work-related burnout, and 37.11 (low) on client/student-related burnout. Frequencies of responses and scores on subscales of the CBI and the item distributions are shown in Table II.

Table I. Participant demographics

Demographics	n (%)
Gender	
Male	4 (3.15)
Female	120 (94.49)
Choose not to respond	3 (2.36)
Age (years)	
20-29	1 (0.79)
30-39	11 (8.66)
40-49	24 (18.90)
50-59	47 (37.01)
60+	44 (34.65)
Ethnicity	
Caucasian	114 (89.76)
African American	4 (3.15)
American Indian or Alaskan Native	1 (0.79)
Hispanic	5 (3.94)
Asian	1 (0.79)
Other	2 (1.57)
Highest education	
Baccalaureate degree	5 (3.94)
Master's degree	98 (77.17)
Doctoral degree	24 (18.90)
Employment Setting	
Two-year technical/community college	85 (66.93)
Four-year program in a dental school	9 (7.09)
Four-year program in a non-dental school	33 (25.98)

When comparing two-year program directors to four-year program directors, an independent samples t-test revealed no statistically significant differences on the overall burnout [t(125)=1.16, p=.25, r=.10], personal burnout [t(125)=0.277, p=.78, r=.02], work-related burnout [t(125)=.998, p=.32, r=.08], or client/student-related burnout [t(125)=1.84, p=.07, r=.16] subscales between groups. Additionally, independent samples t-tests indicated no statistically significant differences on overall burnout [t(125)=0.91, p=.36, r=.08] or any of the three subscale scores [personal burnout: t(125)=0.82, p=.41, r=.07; work-related burnout t(125)=0.58, p=.57, r=.05; and client/student-related burnout t(125)=1.14, p=.26, r=.10] when comparing program directors under 50 years old to those 50 years and older,.

Table II. Frequencies of responses and scores on subscales of Copenhagen Burnout Inventory

Subscale Scores and Questions	Never/ Almost Never n (%)	Seldom n (%)	Sometimes n (%)	Often n (%)	Always n (%)
Personal Burnout **Low: n=48, 37.8% Moderate: n=58, 45.7% High: n=21, 16.5% Severe: n=0, 0.0%**					
How often do you feel tired?	1 (0.79)	9 (7.09)	45 (35.43)	53 (41.73)	19 (14.96)
How often are you physically exhausted?	3 (2.36)	16 (12.6)	41 (32.28)	48 (37.8)	19 (14.96)
How often are you emotionally exhausted?	10 (7.87)	23 (18.11)	52 (40.94)	37 (29.13)	5 (3.94)
How often do you feel worn out?	0 (0)	21 (16.54)	42 (33.07)	51 (40.16)	13 (10.24)
How often do you feel weak and susceptible to illness?	20 (15.75)	39 (30.71)	44 (34.65)	24 (18.9)	0 (0)
How often do you think: "I can't take it anymore?"	20 (15.75)	25 (19.69)	46 (36.22)	32 (25.2)	4 (3.15)
Work-Related Burnout **Low: n=62, 48.8% Moderate: n=55, 43.3% High: n=9, 7.1% Severe: n=1, 0.8%**					
Do you feel worn out at the end of the working day?	2 (1.57)	11 (8.66)	45 (35.43)	51 (40.16)	18 (14.17)
Are you exhausted in the morning at the thought of another day at work?	38 (29.92)	26 (20.47)	42 (33.07)	16 (12.6)	5 (3.94)
Do you feel that every working hour is tiring for you?	46 (36.22)	31 (24.41)	33 (25.98)	14 (11.02)	3 (2.36)
Do you have enough energy for family and friends during leisure time? (reverse scoring)	9 (7.09)	27 (21.26)	45 (35.43)	33 (25.98)	13 (10.24)
Is your work emotionally exhausting?	9 (7.09)	21 (16.54)	49 (38.58)	40 (31.5)	8 (6.3)
Does your work frustrate you?	13 (10.24)	18 (14.17)	65 (51.18)	26 (20.47)	5 (3.94)
Do you feel burnt out because of your work?	15 (11.81)	20 (15.75)	54 (42.52)	28 (22.05)	10 (7.87)
Client/Student-Related Burnout **Low: n=85, 66.9% Moderate: n=36, 28.3% High: n=6, 4.7% Severe: n=0, 0.0%**					
Do you feel that you give more than you get back when you work with students/clients?	25 (19.69)	22 (17.32)	34 (26.77)	34 (26.77)	12 (9.45)
Does it drain your energy to work with students/clients?	23 (18.11)	39 (30.71)	45 (35.43)	16 (12.6)	4 (3.15)
Are you tired of working with students/clients?	40 (31.5)	32 (25.2)	40 (31.5)	15 (11.81)	0 (0)
Do you find it frustrating to work with students/clients?	26 (20.47)	42 (33.07)	48 (37.8)	11 (8.66)	0 (0)
Do you sometimes wonder how long you will be able to continue working with students/clients?	20 (15.75)	30 (23.62)	36 (28.35)	35 (27.56)	6 (4.72)
Do you find it hard to work with students/clients?	40 (31.5)	41 (32.28)	40 (31.5)	6 (4.72)	0 (0)

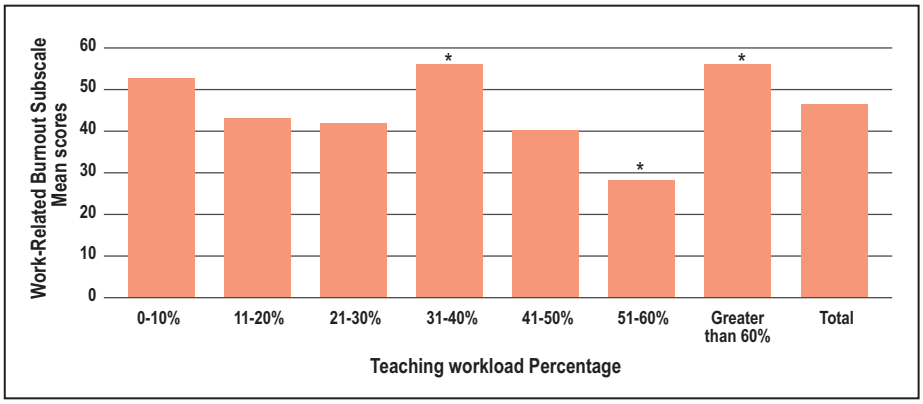
Percentages of workload allocations for administrative, teaching, and research/scholarly activities are summarized in Table III. Comparisons of overall CBI and subscale burnout mean scores in each category were conducted using one-way, between-subjects ANOVA analyses. No statistically significant differences were found for overall CBI mean scores or any of the subscales based on administrative or research/scholarly activity workloads (p-values>0.05). However, there were statistically significant differences identified when comparing teaching workloads for program directors on the work-related burnout subscale ($F(6, 126) = 2.942$, $p = 0.010$). Tukey post hoc tests revealed program directors with teaching workloads of 51-60% indicated significantly lower burnout on the work-related burnout subscale when compared to program directors with teaching workloads of 31-40% (x=29.76, x=55.36, respectively; $p = 0.045$) and greater than 60% (x=29.76, x=55.71, respectively; $p = 0.028$) (Figure 1).

Table III. Mean scores on overall Copenhagen Burnout Inventory and subscales based on workload allocations

Administrative workload allocation	n (%)	Mean Score CBI Total	Mean Score Personal Burnout Subscale	Mean Score Work-Related Burnout Subscale	Mean Score Client/ Student-Related Burnout Subscale
1-10%	3 (2.36)	54.82	61.11	52.38	51.39
11-20%	17 (13.39)	50.31	53.19	49.58	48.28
21-30%	19 (14.96)	50.55	58.33	52.07	41.01
31-40%	12 (9.45)	41.23	47.92	39.88	36.11
41-50%	28 (22.05)	43.00	51.93	43.62	33.33
51-60%	14 (11.02)	48.03	55.36	46.68	42.26
Greater than 60%	34 (26.77)	43.96	54.90	47.06	29.41
Teaching workload allocation	**n (%)**	**Mean Score CBI Total**	**Mean Score Personal Burnout Subscale**	**Mean Score Work-Related Burnout Subscale**	**Mean Score Client-Related Burnout Subscale**
1-10%	20 (15.75)	46.78	55.83	52.14	31.46
11-20%	23 (18.11)	44.57	55.25	43.94	34.60
21-30%	17 (13.39)	42.26	52.21	42.23	32.35
31-40%	16 (12.60)	53.78	61.98	55.36	43.75
41-50%	22 (17.32)	42.82	48.48	41.07	39.20
51-60%	9 (7.09)	32.31	40.74	29.76	26.85
Greater than 60%	20 (15.75)	53.68	58.33	55.71	46.67
Research/scholarly activity allocation	**n (%)**	**Mean Score CBI Total**	**Mean Score Personal Burnout Subscale**	**Mean Score Work-Related Burnout Subscale**	**Mean Score Client-Related Burnout Subscale**
1-10%	111 (87.4)	47.23	55.14	47.84	38.63
11-20%	15 (11.81)	36.84	46.67	38.81	24.72
21-30%	0 (0.00)				
31-40%	1 (0.79)	50.00	45.83	50.00	54.17
41-50%	0 (0.00)				
51-60%	0 (0.00)				
Greater than 60%	0 (0.00)				

Light Orange indicates low scores, Orange indicates moderate scores, Yellow indicates only one participant in the group

Figure 1. Work-related burnout subscale scores based on teaching workload percentages.



*p<0.05 (51-60% when compared to both 31-40% and greater than 60%)

While ANOVA revealed few statistically significant findings related to workload, participants with the lowest workload allocations for administrative duties had higher overall mean burnout scores (Table III). Additionally, those with the lowest workload allocation for administrative duties (1-10%) had moderate average scores for the overall burnout scale (x=54.82), as well as the three subscales (personal x=61.11, work-related x=52.38, client-related x=51.39) which were not seen with any other groups of workload allocation. Program directors with high teaching workload allocations (greater than 60%) also had moderate average scores on the overall CBI (x=53.68) and two of the subscales (personal x=58.33, work-related x=55.71), though average scores were low for the client/student-related burnout subscale (x=45.67).

Participants responded to open-ended questions related to personal and professional factors that contribute to stress and overall feelings of burnout (Table IV). Over one quarter of the respondents identified stressors (27.5%, n=35) related to budget concerns, college policies, and college politics, while 21.6% (n=27) identified faculty and/or staff management as major contributory factors to stress and burnout. Another notable stressor recognized by participants was the lack of time during each workday to complete tasks, excessive hours worked, and excessive duties added on an annual basis with no time allotted for completion (16.5%, n=21). When participants were asked whether they had ever considered leaving their position as an administrator due to stress, more than two thirds (69.29%, n=88) responded "yes."

Table IV. Response frequencies regarding personal and professional factors contributing to stress or burnout

Response	Frequency n (%)
Other or upper administration/ administrative issues	35 (27.5)
Faculty and/or staff management	27 (21.26)
Not enough time, excessive hours, more duties each year with no time	21 (16.5)
Personal needs (raising kids, exercise, health, furthering personal education)	13 (10.24)
Students (change in work ethic, increased neediness, student behaviors and expectations etc.)	12 (9.45)
CODA/Accreditation	11 (8.66)
Balance of workloads (e.g. teaching and administrative)	8 (6.30)
Amount of paperwork/reports	6 (4.72)
Holding two administrative positions (e.g. Program Director and Clinic Director)	3 (2.36)

Discussion

Workplace burnout is a complex interplay of stressors that cause physical, emotional, and mental exhaustion. Decreasing energy, control, and resources in the presence of excessive demands associated with burnout make job satisfaction, motivation, and career growth difficult. The multiple demands of dental hygiene program administrators including administrative issues, budget management, accreditation, and workload allocations may place them at risk for burnout.

Results from this survey indicate approximately one out of two dental hygiene program directors are experiencing some type of burnout, with the highest prevalence scores in the personal burnout category. Personal burnout scores measure how tired or exhausted individuals feel. In general, these results suggest high numbers of dental hygiene program directors are experiencing both physical and psychological fatigue. A comparison of scores from the personal burnout subscale with the work and student-related subscale scores, suggests some of the participants' exhaustion and burnout levels may be related to non-work factors, such as health or family concerns. Struggling to find a balance between home and work life may also contribute to feelings of exhaustion experienced by female program directors who responded. These findings were also demonstrated with responses to open-ended questions, with participants reporting personal factors contribute to feelings of stress and burnout. These results are similar to a previous study of female athletic training program directors, who were more likely to experience emotional exhaustion than their male counterparts related to burnout.[26] In this study, the vast majority of participants were female (95%) suggesting that traditional gender roles may explain the prevalence of high scores on the personal burnout subscale.

Results on the work-related burnout subscale revealed that more than one half the respondents had moderate to severe burnout. This subscale examines the level of psychological and/or physical fatigue, in addition to perceived exhaustion, as it relates to an individual's work. Findings from this study are congruent with other studies of burnout in health care professions where the number of working hours, higher workloads, and other exhausting work factors, significantly contribute to burnout among health care workers.[12,24,27,33,35] When evaluating workload and burnout scores, it was hypothesized that experienced faculty with heavy administrative, teaching, and/or scholarly activity workloads

would score higher on professional burnout subscales, however results from this study did not support this concept. Participants scored low to moderate on overall burnout and subscales regardless, of their workload allocations. However, those with the least amount of workload allocation for administrative duties (1-10%) scored in the moderate range on the overall burnout index, as well as all three subscales. No other administrative workload allocations resulted in moderate burnout on all subscales or on the overall instrument. The stress of trying to balance teaching, service, and possibly research responsibilities, with minimal administrative release time, likely contributes to this finding.

Research suggests professionals who maintain constant relationships with other individuals with small recovery times, are more likely to experience prolonged fatigue and burnout.[12,29,30] Program directors with minimal release time would experience extremely small recovery times in completing various administrative and teaching tasks, leading to prolonged fatigue and mental exhaustion. These factors may also contribute to data suggesting that the majority of respondents had considered leaving their administrative positions due to stress. Similar results were found with medical residency program directors, where 85% of the participants meeting the criteria for burnout, had considering resigning in the preceding year.[22]

For most participants, results on the client/student-related burnout subscale indicated working with students was not central to the overall burnout dental hygiene program directors experience; a majority of the respondents scored low on the client/student-related burnout subscale. Program directors may find working with students a rewarding part of their workday, unrelated to administrative or work demands as a program director. It is also possible that as a program director, less time is spent working with students. Moreover, the typically small class sizes in dental hygiene programs and the ability to spend up to two years with the same cohort of students may lend itself to more personalization, resulting in more positive experiences. Several participants noted that they enjoyed working with students and did not feel that this contributed to feelings of burnout.

Results related to other demographics suggest neither age nor academic setting affect overall or subscale burnout scores in program directors, since the mean scores were relatively similar among age groups and regardless of employment setting. This contrasts with other studies indicating that younger participants had higher burnout scores.[31-33] While these studies indicated a lack of professional maturity and confidence were possible contributors to burnout, this was not reflected in the results in this study. Dental hygiene program directors had moderate to high prevalence rates of burnout related to personal and work-related factors, regardless of demographics or employment settings.

Moderate, high or severe burnout, whether personal or work-related, would suggest that administrators in higher education need to be proactive in identifying and alleviating burnout in midlevel administrators, such as dental hygiene program directors, since burnout is detrimental to an individual's overall health and may even effect health care outcomes.[3-11] Moreover, burnout negatively impacts the work unit as a whole. Workplace health promotion programs designed to reduce occupational stress, enhance coping resources, and propose interventions for prevention and treatment are recommended to reduce burnout,[27,34] On-site childcare and flexible work schedules with remote access may decrease workplace stress. Flextime policies could permit program directors to determine their work hours, while a flexplace policy would allow directors to determine where they will work.[35] While full time flexible scheduling may not be always be a realistic option, remote access and part-time flexible scheduling might be feasible and reduce stressors. Increased flexibility might allow program directors to schedule some work hours to align with public transportation and childcare schedules, reducing stress and burnout.[35] In general, reviewing and addressing environmental issues contributing to stress, such as noise, lighting, temperature extremes, air quality, and ergonomic factors may also help alleviate stressors in the workplace.[36,37]

Dental hygiene program directors may benefit from evidence-based stress management workshops designed to promote strategies for dealing with work stressors. Physical fitness activities, in particular, are recommended as stress relievers. However, implementation of physical activity programs may be challenging for overworked dental hygiene directors, especially considering all of the personal factors contributing to burnout. Results from this study support previous recommendations for stress and burnout prevention in this population including training in time management, relaxation, and nutritional guidance.[27] Workplace burnout may result in increased turnover of dental hygiene program directors. Institutions of higher education should value stress reduction techniques as a means to decrease turnover rates and increase career longevity of their program administrators.

There are several limitations that may have impacted the results of this study. Program directors experiencing burnout may have been more likely to respond to the survey, resulting

in an over-representation of burnout experiences. Burnout prevalence was measured through self-report which may have caused bias in the key variables. The low response rate (39%) also limits generalization of the results; it cannot be assumed that these findings are representative of all US dental hygiene program directors. Additionally, many respondents indicated factors that may influence burnout experiences that were not measured with the CBI instrument, including upper administration, budget constraints, and faculty interactions. Future research should focus on the impact of burnout on career satisfaction and longevity in dental hygiene program directors, prevalence in graduate and post-licensure programs, and best practices for prevention.

Conclusion

Results from this study suggest that one out of two dental hygiene program directors have experienced symptoms of some type of burnout. Among the three dimensions evaluated, the prevalence of personal burnout was the highest level identified, suggesting that work-life balance may be the greatest challenge contributing to burnout among dental hygiene program directors. Furthermore, administrators with the lowest workload allocation for administrative duties had the highest burnout scores, indicating that lack of time to accomplish the required duties associated with their position, may increase burnout. Findings from this study underscore the need for further research to identify stressors associated with burnout as well as identify prevention strategies that promote a healthier work climate for dental hygiene program administrators. Additionally, future research should also explore the impact of burnout on the career longevity of dental hygiene program directors.

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Self-Care Practices of Dental Hygiene Students

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Abstract

Purpose: Little is known about the self-care practices of dental hygiene students. The purpose of this study was to explore the self-care practices among dental hygiene students to examine the relationships between self-care practices, work hours, and caregiver responsibilities.

Methods: The validated Health-Promoting Lifestyle Profile [HPLP II] survey was used to assess a convenience sample of dental hygiene students (n=416) in the United States (US) and Canada. The survey instrument consisted of 61 items in six subscales; spiritual growth, nutrition, interpersonal relations, health responsibility, physical activity, and stress management and was distributed to dental hygiene students through program directors and student social media sites. Data was analyzed using correlation, Mann-Whitney U, Kruskal-Wallace and regression to explore relationships between the variables.

Results: Eighty-one percent of the target population opened the link and completed the survey (n=337). Mean scores for interpersonal relations (M=3.00) and spirituality (M=3.03) subscales indicated respondents were often engaging in these behaviors. Mean scores for physical activity (M=2.26), stress management (M=2.31), nutrition (M=2.44), and health responsibility (M=2.30) sub-scales suggested respondents sometimes practiced these health promoting behaviors. Respondents working more off-campus hours reported stress management behaviors less frequently ($p<0.05$). Participants with children living in the home had the median scores of stress management behaviors (Md=2.07, IQR=0.41) across all types of living situations ($p=0.002$).

Conclusion: Outcomes from this study identified the need for improvement in health promoting behaviors related to nutrition, physical activity, and stress management in dental hygiene students. In addition, students with off-campus work and caregiver obligations may need additional assistance with self-care and stress management strategies to support academic success, given the academic and clinical rigors of the dental hygiene program.

Keywords: dental hygiene students, self-care, wellness behaviors, stress management, health promotion

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Introduction

Self-care, actions taken by an individual to support their personal well-being, is essential to prevent disease and maintain health.[1,2] Individuals who engage in self-care and health-promoting activities have been shown to experience life satisfaction, improved health status, and a general sense of well-being.[3] Major components that contribute to a healthy lifestyle include a sense of personal responsibility for one's health, nutrition, physical activity, spiritual growth, sleep, and stress management.[4,5] Self-care also encompasses making time for self-reflective and social activities, including spending time with family and friends, going to movies, and vacationing. Participating in mindfulness activities such as meditation, yoga, and religious practices are considered part of self-care.[6]

Dental and dental hygiene curricula can be very stressful, resulting in negative impacts on students' health.[7,8] The most significant stressors for dental hygiene students are academic performance in didactic and clinical courses, general workload, patient care, and licensure exams.[9,10] In addition, students can also experience increased stress due to the demands of employment, family, and social obligations.[3,10] Significant amounts of stress for dental and dental hygiene students can impact their mental, physical health, and performance as well as quality of life.[8,10] Stress can lead to

psychological problems including anxiety, depression, and burnout.[9] There are growing concerns that this stressful educational environment may lead to exhaustion and burnout before graduates enter the workforce. This can be particularly problematic considering that dental hygiene has been identified as a high-risk profession for burnout due to work stress, musculoskeletal disorders, long work hours, patient demands, job dissatisfaction, and work-life balance.[10-12] Neglecting self-care can lead to stress-related illnesses, including digestive disorders, decreased immunity, sleep issues, depression, headaches, irritability, and anger.[3,6]

Self-care is especially important among health professionals, because they are viewed as role models for patients.[2,3] Early interventions in self-care behaviors are critical to incorporate into the health care programs to assist in educating future health care providers in stress management and self-care strategies. Students can gain the necessary skills to handle stress once in the work force, minimize adverse health risks and potential job dissatisfaction.[6,13] Self-care practices among health care students are critical due to the many challenges encountered during the education process.[3,13,14] In a review of the literature, Younas found that while nursing students were aware of the importance of diet, sleep, and exercise, they neglected their own self-care practices due to work overload, academic stress, and lack of effective self-care strategies.[14] Other researchers have examined nursing students' perspectives on self-care and health promotion and found that perceptions of students' own health were correlated with their personal patterns of sleep, exercise, and diet.[15] Additionally, these nursing students expressed interest in improving their health and needed guidance from educators.[15]

Avenues for addressing health care student concerns may include incorporating self-care interventions in their respective professional programs and assistance in understanding the importance of self-care.[13] Health care educators should assess self-care behaviors and identify the challenges students may be facing early in the education process, to assist in maintaining or improving self-care behaviors.[14-16] Outcomes from previous research suggest that including health promotion criteria in courses, may encourage healthy behaviors in students.[3] Educators are well positioned to teach self-care and model health promoting behaviors to assist students in incorporating health promotion and self-care strategies.[15] A study by Stark et al. included a self-care intervention in a required course for nursing and occupational therapy students and found an increase in health promoting behaviors and overall health responsibility in the participants.[3] Another study conducted by Ashcraft and Gatto integrated health promotion interventions over a three year time frame into the course content of a nursing program.[13] Students created a care plan that included self-care goals, implementation, evaluation, and self and peer reflection.[13] Likewise, Stark et al evaluated self-care behaviors amongst nursing students as well as other student health professions.[3] Both studies demonstrated significant increases in healthy behaviors among students receiving the curricular intervention.[3,13]

Current research on self-care for health professions students has focused on nursing programs. Little is known about self-care practices among dental hygiene students. The purpose of this study was to explore the self-care practices of dental hygiene students and examine the relationships between self-care practices, work hours, and caregiver responsibilities.

Methods

A cross-sectional survey research design was used to assess a convenience sample of dental hygiene students (n=416) in the US and Canada. The validated Health-Promoting Lifestyle Profile [HPLP II] survey[19,20] was distributed on dental hygiene social media sites and through dental hygiene program directors. Non-probability sampling, along with a snowball sampling technique, was utilized for recruitment. Inclusion criteria were being >18 of age, ability to read and understand English, and current enrollment in an entry-level dental hygiene program. A power analysis (G*Power),[17,18] for a point biserial correlation, medium effect size (R2=.3), α=.05, and 80% power, suggested a minimum sample size of n=80. A target sample size of 155 was recommended to account for attrition of 30%. The MCPHS University's Institutional Review Board granted exempt status to this study.

Survey instrument

The final survey instrument included 61 questions that included the HPLP II instrument (52 items) and demographic questions (9 items). Permission for the use of the Health-Promoting Lifestyle Profile [HPLP II][19,20] was obtained from the authors. The HPLP II contained the following six subscales designed to measure elements of a health-promoting lifestyle: health responsibility (9 items), physical activity (8 items), nutrition (9 items), spirituality (9 items), interpersonal relations (9 items), and stress management (8 items). Responses used a 4-point Likert scale (never, sometimes, often, and routinely) and were scored by averaging each item related to the six subscales. A total health promoting score was calculated by averaging the participants' responses across all 52 items from the HPLP. Mean sub-scale scores >2.5 were considered to be more positive.

Procedures

An invitation to participate in a web-based survey were posted on dental hygiene student social media sites including seven different Facebook and Instagram pages; follower numbers for the social media sites ranged from 1000 to

over 172,000. Due to the initial low response rate, emails to directors of dental hygiene programs in the US (n=291) and Canada (n=15), were sent requesting assistance in the survey invitation dissemination. Twenty-two program directors agreed to disseminate the invitation to participate. Reminders were posted on social media sites weekly and the survey was open for approximately six weeks. There was no follow-up with program directors because an adequate sample size had been reached.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS23®, IBM; Armonk, NY, USA) software. Sample demographics and survey responses were summarized and reported with measures central tendency and variance (e.g., standard deviation, IQR). Variables were analyzed for statistical assumptions including normalcy and co-linearity and were assessed for transformation to address issues of non-normal distributions. Outliers were identified and removed, however, if the findings were consistent when including outliers, those cases were used in the main analysis. To explore the relationship between variables, Correlation, Mann-Whitney U, Kruskal-Wallace and regression were used. Adjustments to family-wise error (e.g., Bonferroni) were made for multiple statistical tests, where appropriate. Acceptable alpha level was set at .05, and all measures of effect size (e.g. 95% Confidence Interval, R2, Phi Coefficient) were determined.

Results

Four hundred and sixteen surveys were opened; 79 participants were removed because they did not complete any survey questions for a completion rate of 81% (n=337). Seventy-two percent of the sample identified as white, 11% as Hispanic or Latino, 3% as black or African American. The mean age of participants was 25.3 years (SD=6.6), 96% were female (n=323), and worked, outside of school, an average of 21.0 hours (SD=14.6) weekly (n=173). The average number of hours students were employed in jobs on campus was M=22.3 hours (n=40; SD=16.2, 95%CL [17.1, 27.4]) versus off campus jobs was M=17.2 hours (n=160; SD=9.3, 95%CL [15.7, 18.6]). The combined total of those who were employed (on/off campus) and those who were not, is less than the total sample size because some participants did not provide the number of hours worked. Forty-one percent reported caregiver obligations outside of work hours. Demographic variables are summarized in Table I.

The six subscales demonstrated excellent reliability (α=0.84). Descriptive statistics for the items in the HPLP II (mean score for each subscale and total HPLP score) are presented in Tables II and III. The interpersonal relations (M=3.00, SD=0.51, 95%CI [2.94, 3.05]) and spirituality (M=3.03, SD=0.51, 95%CI [2.98, 3.09]) subscales showed the highest mean scores while physical activity scores (M=2.26, SD=0.65, 95%CI [2.19, 2.32]) suggested that students often practiced these behaviors. Stress management (M=2.31, SD=0.51, 95%CI [2.26, 2.36]), and health responsibility (M=2.30, SD=0.56, 95%CI [2.24, 2.36]) were average frequencies, suggesting students sometimes practice those health promoting behaviors.

To examine the relationship between health promoting lifestyle and age, hours worked weekly, (both on and off campus) each of the subscales and the total HPLP score were analyzed using Spearman's Rank Order correlations. As age increased, the frequency of health responsibility (rho=0.16, $p<0.001$) and health promoting behaviors also increased. Working more hours on campus was also associated with an increase in frequency of the health responsibility behavior (rho=0.39, $p<0.05$). Increased off campus work hours were associated with decreases in the frequency of stress management health promoting behaviors (rho=-0.19, $p<0.05$). All other correlations between age and hours worked (total, on and off campus) were not statistically significant ($p>0.05$) (Table IV).

A Kruskal-Wallace test of medians was used to examine median differences for each categorical demographic variable and the subscale scores. Participants living at home with children, had the lowest frequency of stress management behaviors (Md=2.07, IQR=0.41) across all living situations ($p=0.002$). Each subscale and overall scores by living situation is shown in Table V. A Bonferroni correction was calculated to adjust for family wise error and resulted in a new p-value cutoff of $p<0.007$. All other tests between living situation and subscales scores, fell above $p>0.007$, and were not statistically significant.

To examine whether those with caregiver and work responsibilities had different frequencies of health promoting behaviors as compared to respondents without caregiver and work responsibilities, a Mann-Whitney U was conducted comparing the median scores of the two groups for each subscale along with overall health. Participants without caregiver or work responsibilities had a higher median frequency of health promoting behaviors (Md=2.25, IQR=1.00) than those with caregiver and work responsibilities (Md=2.13, IQR=0.88) ($p=0.047$). Additionally, participants without caregiver or work responsibilities had a higher median frequency of stress management behaviors (Md=2.37, IQR=2.25) than those with caregiver responsibilities (Md=2.15, IQR=0.50). It is notable that the IQR for median stress management behaviors amongst those without caregiver or work responsibilities

Table I. Sample demographics (n=337)

			95% Lower CL**	95% Upper CL**
	n*	%	%	%
Age (n=335)				
18 to 30	284	84.8	80.6	88.3
31 to 40	42	12.5	9.3	16.4
41 to 50	4	1.2	0.4	2.8
51 to 60	3	0.9	0.3	2.4
60+	2	0.6	0.1	1.9
Gender (n=337)				
Male	13	3.9	2.2	6.3
Female	323	95.8	93.3	97.6
Transgender	—	—	—	—
Prefer not to say	1	0.3	0.0	1.4
Ethnicity (n=336)				
White	242	72.0	67.1	76.6
Black or African American	17	5.1	3.1	7.8
Native American	3	0.9	0.3	2.4
Hispanic or Latino	39	11.6	8.5	15.4
Asian or Pacific Islander	24	7.1	4.8	10.3
Other	11	3.3	1.8	5.6
Location (n=337)				
US	318	94	91.5	96.5
Canada	19	6.0	3.5	8.5
Housing situation				
Live at home with parent(s)	115	34.1	29.2	39.3
Dorm	25	7.4	5.0	10.6
Apartment or house independently	70	20.8	16.7	25.3
With significant other	81	24.0	19.7	28.8
With significant other and children	46	13.6	10.3	17.6
Marital status				
Married	80	23.7	19.4	28.5
In a relationship	142	42.1	37.0	47.5
Single	108	32.0	27.2	37.2
Divorced	7	2.1	0.9	4.0
Widowed	0	0.0	—	—
Caregiver obligations				
Children	55	16.3	12.7	20.5
Parents	27	8.0	5.5	11.3
Grandparents	8	2.4	1.1	4.4
Other outside commitments	49	14.5	11.1	18.6
None	198	58.8	53.4	63.9

*Sample sizes (n) vary; not all participants answered each of the demographic questions

** Confidence levels for the proportion.

indicated considerable variance within that category. All other comparisons of median subscale scores or total health promoting behaviors between the two groups were nonsignificant ($p>0.05$).

Discussion

This study explored self-care practices among dental hygiene students. Study findings indicated that dental hygiene students scored slightly higher than the HPLP II mean subscale score of >2.5 for the interpersonal and spirituality subscales however physical activity, stress management, health responsibility, and nutrition had lower mean scores, demonstrating a need for improvement in self-care practices to help support academic success. Relationships between demographic variables and self-care behaviors among dental hygiene students were examined and it was found that frequencies of healthy responsibility promoting behaviors increased with age. Differences in self-care behaviors were also noted among the respondents based on their living situation. To evaluate the relationships more in depth, differences in self-care behaviors among students who worked and had caregiver obligations were compared to those who did not. The findings demonstrated a negative association with the total number of hours worked per week, and positive nutrition behaviors.

A mean score of ≥2.5 on the HPLP II survey instrument,[15] suggests positive health behaviors. The mean total health score for participants in this study was 2.57, indicating a slightly positive health promoting lifestyles in the sample population. However, when comparing the mean score of these participants to other health professions, dental hygiene students scored lower. Stark et al noted a mean score of 2.88 on the HPLP II pretest among students in allied health profession programs (not including dental hygiene).[3] In another study by Stark et al, Arab nursing students reported an average score of 2.64

Table II. Item response frequencies (n=337)

	Never/ Sometimes	Sometimes/ Always
	n (%)	n (%)
Health Responsibility		
Report any unusual signs or symptoms to physician or other health professional.	167 (49.6)	170 (50.4)
Read or watch TV programs about improving health.	270 (80.1)	67 (19.9)
Question health professionals in order to understand their instructions	148 (44.0)	188 (56.0)
Get a second opinion when I question my health care provider's advice.	252 (74.8)	85 (25.2)
Discuss my health concerns with health professionals.	165 (49.1)	171(50.9)
Inspect my body at least monthly for physical changes/ danger signs	202 (59.9)	135 (40.1)
Ask for information from health professionals about how to take good care of myself.	222 (65.9)	115 (34.1)
Attend educational programs on personal health care.	283 (84.0)	54 (16.0)
Seek guidance or counseling when necessary.	201 (59.6)	136 (40.4)
Physical Activity		
Follow a planned exercise program.	243 (72.1)	94 (27.9)
Exercise vigorously for 20 or more minutes at least three times a week (such as brisk walking, bicycling, aerobic dancing, using a stair climber).	222 (65.9)	115 (34.1)
Take part in light to moderate physical activity (e.g. sustained walking 30-40 minutes 5 or more times a week).	229 (68.2)	107 (31.8)
Take part in leisure- time (recreational) physical activities (such as swimming, dancing, bicycling).	249 (73.9)	88 (26.1)
Do stretching exercises at least 3 times per week.	244 (72.4)	93 (27.6)
Get exercise during usual daily activities (such as walking during lunch, using stairs instead of elevators, parking car away from destination and walking).	113 (33.5)	224 (66.5)
Check my pulse rate when exercising.	235 (69.9)	101 (30.1)
Reach my target heart rate when exercising.	215 (64.0)	121 (36.0)
Nutrition		
Choose a diet low in fat, saturated fat, and cholesterol.	240 (71.2)	97 (28.8)
Limit use of sugars and food containing sugar (sweets).	235 (69.7)	102 (30.3)
Eat 6-11 servings of bread, cereal, rice and pasta each day.	260 (77.2)	77 (22.8)
Eat 2-4 servings of fruit each day.	211 (62.8)	125 (37.2)
Eat 3-5 servings of vegetables each day.	203 (60.2)	134 (39.8)
Eat 2-3 servings of milk, yogurt or cheese each day	173 (51.5)	163 (48.5)
Nutrition (continued)		
Eat only 2-3 servings from the meat, poultry, fish, dried beans, eggs and nuts group each day.	150 (44.5)	187 (55.5)
Read labels to identify nutrients, fats and sodium content in packaged food.	154 (45.7)	183 (54.3)
Eat breakfast.	158 (46.9)	179 (53.1)
Spiritual Growth		
Feel I am growing and changing in positive ways.	101 (30.0)	236 (70.0)
Believe that my life has purpose.	60 (17.8)	277 (82.2)
Look forward to the future.	36 (10.7)	301 (89.3)
Feel content and at peace with myself.	170 (50.4)	167 (49.6)
Work toward long-term goals in my life.	27 (8.0)	310 (92.0)
Find each day interesting and challenging.	138(40.9)	199 (59.1)
Am aware of what is important to me in life.	41 (12.2)	294 (87.8)
Feel connected with some force greater than myself.	139 (41.2)	198 (58.8)
Expose myself to new experiences and challenges.	137 (40.7)	200 (59.3)
Interpersonal Relations		
Discuss my problems and concerns with people close to me.	144 (42.7)	193 (57.3)
Praise other people easily for their achievements.	44 (13.1)	293 (86.9)
Maintain meaningful and fulfilling relationships with others.	61 (18.2)	275 (81.8)
Spend time with close friends.	146 (43.3)	301 (89.3)
Find it easy to show concern, love and warmth to others.	63 (18.8)	273 (81.3)
Touch and am touched by people I care about.	65 (19.3)	271 (80.7)
Find ways to meet my needs for intimacy.	167 (49.6)	170 (50.4)
Get support from a network of caring people.	89 (26.4)	248 (73.6)
Settle conflicts with others through discussion and compromise.	99 (29.5)	237 (70.5)
Stress Management		
Get enough sleep.	227 (67.4)	110 (32.6)
Take some time for relaxation each day.	185 (54.9)	152 (45.1)
Accept those things in my life which I cannot change.	154 (45.7)	183 (54.3)
Concentrate on pleasant thoughts at bedtime.	211 (62.6)	126 (37.4)
Use specific methods to control my stress.	227 (67.4)	110 (32.6)
Balance time between work and play.	186 (55.2)	151 (44.8)
Practice relaxation or meditation for 15-20 minutes daily.	285 (85.1)	50 (14.9)
Pace myself to prevent tiredness.	240 (71.4)	96 (28.6)

Table III. Subscale scores (n=337).

	Mean	SD	Lower 95% CL	Upper 95% CL
HPLP Sub-Scales				
Physical Activity	2.26	.65	2.19	2.32
Health Responsibility	2.30	.56	2.24	2.36
Stress Management	2.31	.51	2.26	2.36
Nutrition	2.44	.45	2.39	2.48
Interpersonal Relations	3.00	.51	2.94	3.05
Spirituality	3.03	.51	2.98	3.09
HPLP Total Score	2.57	.40	2.52	2.61

While the overall mean HPLP score of 2.57 in this study is considered slightly positive, the actual health promoting frequency behaviors of the participants was more nuanced. Dental hygiene students fell below the cut-off of 2.5 on four out of six HPLP subscales including health responsibility, physical activity, nutrition, and stress management. While a score of ≥2.5 suggested slightly positive self-care behaviors, dental hygiene students would benefit from improvement in the majority of subscales.

In this study, more than half of the respondents (71%) reported sometimes or never choosing a diet low in fat, limited sugar intake (69.7%), ate 2-4 serving of fruit (62.8%), ate 3-5 serving of vegetables (60.2%), or ate 2-3 serving dairy (51.5%). All these intakes are aspects of a healthy diet based on the 2015-2020 Dietary Guidelines for Americans[21] and poor eating patterns increase the risk for many chronic diseases.[1,22] Students who lived with parents or in a dorm also had the lowest nutritional scores suggesting that students living in

Table IV. Demographic variables and subscale scores, Spearman's rank order correlations (n=337)

	Total	Health Responsibility	Physical Activity	Nutrition	Spirituality	Interpersonal Relations	Stress Management
Age	-.03	.16**	-.07	.02	-.10	-.10	-.08
Total hours	-.09	-.02	-.01	-.19*	.002	-.05	-.15
Off campus	-.12	-.12	.06	-.20*	-.02	-.02	-.19*
On campus	.07	.39	-.16	-.13	.08	-.01	-.06

*$p<0.05$ **$p<0.001$

Table V. Subscale scores by living situation* (n=337)

	R		P		N		S		I		Str		O	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Live at home with parent(s)	2.22	.57	2.18	.63	2.35	.47	2.99	.62	2.93	.57	2.29	.54	2.50	.44
Dorm	2.06	.54	2.22	.57	2.38	.53	3.03	.60	2.92	.64	2.42	.50	2.51	.44
Apartment or house independently	2.35	.52	2.44	.73	2.47	.45	3.08	.47	3.10	.50	2.43	.53	2.65	.38
With significant other	2.42	.55	2.34	.64	2.53	.42	3.08	.40	3.09	.41	2.33	.45	2.65	.34
With significant other and children	2.33	.57	2.04	.54	2.43	.40	3.00	.42	2.90	.44	2.07	.43	2.48	.33

*R=Health Responsibility, P=physical activity, N=nutrition, S=Spirituality, I=Interpersonal relations, Str=Stress management, O=Overall Health score

M=mean subscale score; SD= standard deviation of the mean.

dorms and with parents may need additional support in making healthy eating choices. This finding is consistent with research suggesting students living in dorms are not making healthy food choices.[23] In a study of nursing students, fruit and vegetable consumption improved following a self-care intervention in the curriculum;[13] a similar intervention could be implemented for dental hygiene students to increase healthy diet choices and improve their nutrition.

Exercise plays an important role in physical and mental health.[24] Two-thirds of the respondents in this study (66.0%) reported that they never, or only sometimes, exercised (e.g., brisk walking, bicycling, aerobic dancing) vigorously for 20 or more minutes at least 3 times a week; and 72% reported never, or only sometimes, performed regular stretching exercises. These findings were similar to a study where 70% of the nursing students reported that they did not exercise enough.[15] Lack of physical activity is especially concerning since dental hygiene students need to learn good self-care behaviors to manage stress and avoid burnout later in the profession.[9,13] In the previously cited nursing student study, it was suggested that educators assist students in developing methods to improve and maintain self-care practices.[15] Additional suggestions for educators include guidance on time and stress management and making healthy lifestyle choices.[15] Supporting students in their development of self-care behaviors during their entry-level professional education may also result in their ability to educate and model healthy lifestyle behaviors for their patients.[15]

Results from this study also identified an association between work hours and survey subscales. Higher numbers of hours worked off campus per week were correlated with poorer nutrition habits and fewer stress management health promoting behaviors. A study by Garcia-Vargas et al. demonstrated that paid work during nursing students' studies had a negative impact on student academic success.[25] Findings from the current study may be helpful in supporting recommendations for students to work fewer hours during their dental hygiene education program.

Overall the findings suggest the need to educate and support students in managing stress and practicing daily self-care to support academic success.[9,24] Implementation of stress management strategies into course curriculum should be considered.[13] Recognizing the need for self-care early among students and providing the appropriate interventions can help decrease poor self-care practices among students.[13] Findings from this study indicated that dental hygiene students need improvement in the following subscales: health responsibility, physical activity, nutrition, and stress management. By educating students on self-care and incorporating health promotion activities into the curriculum, students can develop an understanding of the behaviors needed to support success during the program with the goal of continuing these behaviors once they enter the workforce.[13]

The non-probability sampling and possibility of self-report bias limit the generalization of the study findings. The availability of the survey at the beginning of the fall semester presented challenges as students may have been less willing to participate due to the timing. Also, due to the low initial response rate on social media, program directors were used to invite students to participate in the survey. It is possible that some participants could have completed the survey more than once. The type of education program and the participant's year in the program were not included in the demographics limited additional comparisons, however the use of a validated survey and findings similar to those of nursing students were strengths of this study.

Future research recommendations include the need to identify effective interventions, including exploring complementary alternative therapies, to enhance student self-care. Further studies are needed to examine dental hygiene student self-care practices on a larger scale and study longitudinal changes within the academic program to better tailor interventions to support students.

Conclusion

Dental hygiene students in this study were not adequately engaging in health promoting self-care behaviors related to nutrition, physical activity, and stress management behaviors. Caregiver and work obligations negatively correlated with mean health behavior scores. Dental hygiene students experienced stressors from family, employment, and academic sources. Dental hygiene education programs should consider implementing self-care interventions focusing on overall health to support academic success and career longevity.

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Prevention and Reduction of Musculoskeletal Pain Through Chair-Side Stretching among Dental Hygiene Students

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Abstract

Purpose: Musculoskeletal disorders (MSD) are among the most commonly reported injuries in the workforce and there is a particularly high prevalence among dental hygienists. Research has shown that the incidence of MSD may begin during students' academic and clinical training. The purpose of this study was to determine the effectiveness of implementing chair-side stretching exercises on self-reported musculoskeletal (MSK) pain among currently enrolled dental hygiene students.

Methods: A total of 31 senior dental hygiene students were divided into treatment and control groups during the fall semester. The treatment group completed a series of chair-side stretching exercises, prior to beginning each clinic session, for approximately 10.5 weeks. Participants completed a modified version of the Standardized Nordic Questionnaire at the beginning (week 0), midpoint (week 5), and end of the study (week 10.5). Descriptive statistics were used to analyze the data.

Results: There were significant differences in the total MSK pain scores reported between the treatment and control groups (p=0.03) in addition to the hand and wrist pain severity scores (p=0.04). Hierarchical multiple regression revealed a model explaining the 38.2% variance in MSK pain between the groups (p=0.021). A majority of participants in the treatment group felt that chair-side stretching exercises neither improved nor worsened their MSK pain. However, more than one-half of the participants felt that the exercises helped increase their conscious level regarding ergonomic practices while delivering patient care.

Conclusion: Findings from this study suggest that consistent chair-side stretching exercises may be beneficial in reducing and preventing MSK pain, particularly within the hand and wrist region. Future research is needed to determine effective interventions to reduce MSK pain, particularly for the neck, shoulders, and lower back during dental hygiene education.

Keywords: dental hygiene students, dental hygiene education, musculoskeletal disorders, ergonomics, musculoskeletal pain, stretching exercises

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Introduction

Musculoskeletal disorders (MSD), degenerative disorders of the muscles, joints, tendons, nerves and blood vessels that are correlated with repetitive, cumulative trauma occurring over time, are among the most commonly reported injuries in the workforce.[1–5] Persistent strain on muscles and joints leads to destructive wear, resulting in pain in the limbs of the upper and lower body.[6,7] Musculoskeletal disorders are often associated with work-related risk factors and affect a variety of professions, including nurses, truck drivers, and musicians.[7–10] Extensive research studies have addressed the elevated risk and prevalence of MSD among dental personnel.[11–17] Dental professionals sit in static positions many hours each day, and bending the neck, raising the shoulders, and exerting force through the hands and arms are among the associated high risk behaviors associated with MSD.[6,18–20]

Dental hygienists perform scaling procedures that require repetitive motions of the arms and hands; actions that are major contributors to MSD pain.[14,19,21] A study of dental hygienists revealed that 93% of respondents reported having some kind of MSD pain within the preceding 12 months and a majority indicated the presence of pain within the wrist or hands, neck, and upper back.[19] A systematic review of the literature by Hayes et al. identified similar results, with neck pain affecting 60% of dentists and dental hygienists.[13] Comparable results

were noted across studies and hand and wrist pain were found to be more common among dental hygienists as compared to dentists or dental assistants.[13] Carpal tunnel syndrome (CTS) is a common MSD among dental hygienists.[19,22] Work-related tasks including repetitive motions combined with powerful exertion of the hands, arms, and wrists are major contributors to its prevalence[19] and CTS has been shown to be the most common MSD diagnosis among dental hygienists and dentists.[22] Causes of MSD among dental hygienists are multifactorial, and predictors are difficult to delineate. Hayes et al. evaluated potential contributory elements, including manual vs. ultrasonic instruments, general vs. periodontal practice settings, and physical and psychosocial factors and found each element to be significant MSD risk among the dental hygienists studied.[14]

Persistent pain from MSD often leads sufferers to seek medical care. Treatment for work-related MSD costs range between 13 to 20 billion dollars annually across all professions in the US.[15] In one study of dental hygienists, nearly one-third of the respondents reported seeking medical treatment for neck and upper back work-related pain.[19] Two additional studies of dental hygienists found that participants experiencing neck and forearm pain are more likely to take time off, call in sick, or decrease work hours.[14,20] Additionally, individuals with pain are more likely to contemplate leaving the profession completely.[14,20] Ultimately, consequences of MSD pain lead to loss in revenue for the practitioner and can negatively impact the profession in general.

Proper ergonomics are vital to avoiding chronic injury and reducing the incidence of MSD among dental professionals and are among the first concepts introduced in clinical dental hygiene education.[6,23] In addition to learning proper ergonomics, the use of adjunctive devices, such as magnification loupes, has been shown to improve ergonomics and the quality of clinical work.[14,24–26] Regularly exercising can also help to reduce and prevent MSD incidence.[27–31] Frequent, periodic work breaks to perform chair-side stretching during the provision of clinical care may reduce the severity of MSD pain.[6,17,18,23,32] Frequent stretching has been shown to stimulate blood flow, increase synovial fluid for joint lubrication, reduce painful trigger points, relax and prepare muscles for strain, and help sustain an efficient range of motion.[6,23]

Multiple studies have evaluated the prevalence of MSD among dental and dental hygiene student populations, and have shown the incidence of MSD occurring during clinical education.[12,27,30,31,33–37] Hayes et al. found that 64% of Australian dental hygiene students reported neck pain, with the majority of respondents stating that it lasted longer than 2 days and interfered with their daily lives; 30% sought medical attention.[28] A subsequent 3-year longitudinal study revealed that pain in these regions increased and became more intense over time during the dental hygiene program.[12] In another study of oral health professionals in Australia, Ng et al. found MSD were prevalent among all participants, was higher in those in their final year of training.[37] Morse et al. evaluated MSD pain in a group of US dental hygiene students with comparable results.[34] Results from these studies demonstrate the significant impact MSD can have on dental professionals during the early years of clinical education.

While evidence of the prevalence of MSD among dental professionals is overwhelming, there are few studies investigating which ergonomic strategies and preventive methods actually contribute to reducing the incidence of MSD among dental hygiene students.[14] A study of licensed dental hygienists in Mississippi found the majority of respondents reported having received general instruction in ergonomics during training, however less than half stated that they received specific lectures regarding MSD.[38] The literature raises concerns regarding the career longevity of future dental professionals, suggesting that dental hygiene educators emphasize proper ergonomics, in addition to other prevention strategies.[12,20,27] A consensus in the literature indicates a need for intervention through improved education of ergonomics, exercise (including stretching regimens), and overall professional awareness of the risk factors.[6,12,14,19,20,27,30,36] Studies by Valachi and Nagpal specifically outline the use of stretching exercises as a preventive strategy for MSD.[6,23] The purpose of this study was to determine the effectiveness of implementing chair-side stretching exercises on musculoskeletal (MSK) pain among dental hygiene students enrolled in an accredited dental hygiene education program.

Methods

Upon IRB approval from The Ohio State University, a randomized control study was designed using a convenience sample of 31 senior dental hygiene students. Fifteen participants were assigned to the treatment group and 16 were assigned to the control group. All participation for the study was voluntary and informed consent was received from the participants. As part of the dental hygiene program clinical rotation schedule, participants had been previously assigned to one of four clinical groups. The investigators used random number assignment software to select two clinic groups as the treatment group and the remaining groups became the control group. The treatment group performed chair-side stretching exercises prior to beginning each clinic session; the control group did not perform any chair-side stretching exercises.

A program of chair-side stretching exercises was created by the principal investigator (PI) and a board-certified physical therapist. The stretches were chosen to exercise the neck, shoulders, back, and hands and wrists. Prior to the study, the treatment group was trained through face-to-face demonstrations by the investigators, to perform the provided set of chair-side stretches. Participants were given written and visual instructions for each stretching exercise as a reference. All of the associated clinical instructors were given the same visual and written instructions in order to familiarize faculty with the study. However, the clinical instructors did not play a role in the study. The series of chair-side stretches took approximately 5 to 7 minutes to complete prior to each clinic session. Examples of the visual instructions provided to the participants are shown in Figures 1a–1c. Treatment group participants were given a log spreadsheet to record the date and time the stretches were performed.

Figure 1a. Scalene stretch: neck

Figure 1b. Wrist extension

Figure 1c. Wrist flexion

Survey instrument

Two questionnaires were used, a modified Standardized Nordic Questionnaire (SNQ) and a qualitative questionnaire regarding the perceptions about the effects of the chair-side stretching exercises. The SNQ was developed by the Nordic Council of Ministers to standardize the evaluation of MSD for epidemiological research, and has been found to be a repeatable, valid resource in measuring MSD.[39–41] Each participant was assigned a study number and evaluated using a modified SNQ[39] three times over the fall semester: beginning (week 0), midpoint (week 5), and end (week 10.5). The modified SNQ evaluated MSK pain in multiple body regions, such as the neck, shoulders, hands and wrists, lower back, and lower extremities using simple "yes/no" responses. An anatomical illustration was provided to help participants answer the questions.[39] The questionnaire included items regarding the length of time pain lasted, whether they had trouble in each body region during the last 7 days, if the pain prevented them from completing daily tasks, and if they have sought medical treatment for MSK pain within the last 12 months.[39] Modifications were made to include demographic data and information on personal habits including alcohol consumption and tobacco use, hours spent in clinic, stress levels, and weekly hours spent exercising. The modified SNQ had a total of 74 items, including the demographic questions, but the length varied depending on the "yes/no" responses and follow-up questions. Treatment group participants also completed a researcher developed, qualitative questionnaire with items regarding their personal feelings about the effects of the stretches on any related MSK pain, whether positive, negative, or neutral.

Data analysis

Data were analyzed using the SPSS statistical software, version 23 (IBM; Armonk, NY, USA). Musculoskeletal (MSK) pain sums were calculated as the total number of body regions the participant responded to having experienced MSK pain in the last 7 days (stated in the first SNQ) or since the last time the questionnaire was administered (stated in the second and third SNQ). Results for the first SNQ were utilized as the baseline for participants' responses. These results were analyzed using a t-test to compare the scores between the treatment group and the control group from the first, second, and third questionnaire. Overall pain severity scores were calculated and classified as no pain (0), mild pain (1), moderate pain (2), or severe pain (3), based on the participant's response to having pain in any body region and the length of time the MSK pain prevented them from doing their normal work. The same calculation and classification was applied for each specific body region, including the

neck, shoulders, hands and wrists, and low back. These results were analyzed using MANOVA to compare the first, second, and third questionnaires among the treatment and control group. A hierarchical multiple regression model was used to analyze the effect of stretching exercises in predicting MSK pain. Demographic and descriptive variables were analyzed to control as possible factors for MSK pain.

Results

Demographics

A total of 31 students participated in the study and completed the SNQ three times throughout the study. Of the total number of participants, 15 students were assigned to the treatment group and 16 assigned to the control group. The majority of the participants were non-smoking females between 21 to 22 years of age. Participants spent an average of 12 to 18 hours in clinic per week; more than half (54.8%) spent an average of 15 hours per week.

MSK pain

Calculations for the sum of MSK Pain were analyzed using a t-test to compare the groups for the first, second, and third SNQ. For each group, the mean scores for the sum of MSK pain was the lowest for the first SNQ and highest among the second SNQ; No statistically significant differences were found between the groups for the first SNQ. Differences in MSK pain score sums were statistically significant between the groups for the second SNQ (p=0.03), however no significant differences were found for the third SNQ (p=0.07). Results for the sums of MSK pain scores (means and standard deviations) for both groups are shown in Table I.

Table I. Musculoskeletal pain sums on SNQ*

	Control (n=16)		Treatment (n=15)		*p*-values
	M	SD	M	SD	
SNQ 1 (baseline)	1.44	±2.15	1.40	±1.59	.95
SNQ 2 (5 weeks)	3.25	±2.20	1.73	±1.43	.03
SNQ 3 (10.5 weeks)	2.81	±2.04	1.60	±1.50	.07

* Standard Nordic Questionnaire

Overall and body region pain severity scores

Results for the overall and each body region pain severity scores were analyzed using MANOVA to compare the first, second, and third SNQs among the treatment and control groups. No statistical significances were found for overall body, neck, shoulders, or low back pain severity scores for the second SNQ between the groups. However, the treatment group had significantly lower pain severity scores in the hands and wrists for the second SNQ (p=0.04). No significant differences were found for the overall or body region pain severity scores for the third SNQ between the groups. Results for the overall pain severity scores (means and standard deviations) are shown in Table II.

MSK pain prediction

Hierarchical multiple regression was used to analyze the relative importance of stretching exercises and behaviors in predicting MSK pain. Demographic variables accounted for 8.5% of the variance in MSK pain in the first step of the regression model and was not found to be statistically significant ($\Delta R2 = .085$, $F(2,28) = 1.307$) ($p = .287$). Exercise and stress variables were added in the second step, explaining an additional 14.6% of the variance in MSK pain, although this did not indicate a statistically significant improvement ($\Delta R2 = .146$ $F(2,26) = 1.958$) ($p = .104$). The final entry of the stretching exercise variable in step three, demonstrated a significant increase in explained variance ($\Delta R2 = .151$, $F(1,25) = 3.092$) ($p = .021$). When all independent variables were included into the fourth stage of the regression model, weight, alcohol consumption, stress and general exercise habits were not found to be significant predictors of MSK pain; and only stretching was found to be significant ($p = 0.021$). Combined, the independent variables accounted for 38.2% of the variance in reported MSK pain.

Perceptions and frequency of chair-side stretching

In response to the qualitative questionnaire, the majority of students felt that chair-side stretching neither improved nor worsened their reported MSK pain. However, more than half felt that chair-side stretching made them more conscious of their ergonomic practice while treating patients. Additionally, 73.3% of participants in the treatment group stated they planned to continue chair-side stretching on occasion after participation in the study.

The average number of stretches completed by the participants in the treatment group between the first and the second NSQ was 3.84 times per week and the average number of stretches between the second and the third NSQ was 2.92 times per week resulting in a 24% decrease in the average number of stretches per week during the second half of the study.

Table II. Pain severity scores on SNQ

Severity Score	Group				
	Control (n=16)		Treatment (n=15)		*p*-values
	M	SD	M	SD	
Overall Pain					
SNQ 1 (baseline)	1.88	±.80	1.40	±.91	.13
SNQ 2 (5 weeks)	1.75	±.77	1.27	±.70	.08
SNQ 3 (10.5 weeks)	1.69	±.70	1.27	±.70	.10
Neck Pain					
SNQ 1 (baseline)	.94	±.57	1.13	±.83	.45
SNQ 2 (5 weeks)	.94	±.57	.93	±.79	.98
SNQ 3 (10.5 weeks)	1.25	±.6	1.00	±.84	.39
Shoulder Pain					
SNQ 1 (baseline)	.56	±.62	.73	±.70	.48
SNQ 2 (5 weeks)	.38	±.61	.67	±.61	.20
SNQ 3 (10.5 weeks)	.44	±.62	.60	±.73	.51
Hands/Wrist Pain					
SNQ 1 (baseline)	1.38	±1.02	.73	±.79	.06
SNQ 2 (5 weeks)	1.25	±1.00	.60	±.63	.04
SNQ 3 (10.5 weeks)	1.06	±1.12	.60	±.73	.18
Low Back Pain					
SNQ 1 (baseline)	1.13	±.88	.80	±1.08	.36
SNQ 2 (5 weeks)	.94	±1.12	.67	±.72	.75
SNQ 3 (10.5 weeks)	.69	±.94	.60	±.50	.74

Discussion

Results of this study were in agreement with current literature regarding the high prevalence of MSK pain among dental hygiene students, which manifests early in clinical education.[12,27,30–32] However, this study was among the first to examine chair-side stretching as an intervention, rather than looking solely at the incidence of MSK pain. Results of the second SNQ showed a statistically significant difference between the groups for the sum of MSK pain ($p=0.03$). However, there was no significant difference observed between the groups at the time of the third SNQ. One explanation for this finding could be related to the decreased compliance of the treatment group in completing the chair-side stretches in the last weeks of the study. The study participants' average number of stretches per week decreased 24% as compared to the first half the study. Participants reported a correspondingly greater reduction in MSK pain during the first half of the study when they reported a greater diligence in completing the stretching exercises and may have been more attentive to participation in the study. These results also suggest that the benefits of chair-side stretching may have been both immediate and transient. Participants expressed perceived benefits of the regimen over the same period of time when stretching was at the highest level of compliance and positive perceptions diminished when compliance waned. Establishing a more effective leadership role among all of the clinical instructors could help to ensure better compliance throughout the test period in future studies.

Musculoskeletal pain levels in the hands and wrists showed a statistically significant difference between the groups in the second SNQ at five weeks. Again, a reduction in pain at five weeks but not at ten weeks could be due to the fact that participants completed more chair-side stretching between the first and second SNQ. Literature has also shown that dental hygienists are at a particularly high risk for developing MSK pain in the hands and wrists and commonly experience CTS[13,14,19,22] which could explain the significance of the hands and wrists MSK pain scores. However, another explanation could be that the stretching exercises selected for the hand and wrist region were more suitable for this specific body region in comparison to those chosen for the neck, shoulders, and low back, and were more effective. Several combinations of chair-side stretching exercises exist, but given the conditions of the learning environment for this study, the participants had a limited amount of time to complete the series before each clinic session, restricting the number of stretches selected for the study. Additionally, the allotted 10.5 week timeframe for this study limited the ability to observe the long-term effects of the stretching exercises on MSK pain.

Although the majority of participants did not feel that stretching improved or worsened their MSK pain, two-thirds (66.7%) felt stretching increased their awareness of their ergonomic practices while providing patient care. The ergonomic practices of the study participants were not monitored or altered, as it was an uncontrollable factor that could influence the outcome of

the intervention. However, over the course of their clinical education, the participants had been taught how to practice proper ergonomics and were encouraged to maintain those practices. Research suggests that performing proper ergonomic posture can improve and reduce the development of MSD.[6,23] However, the body trunk is the focus of these postural suggestions, with few recommendations for hands and wrists.[6,23] Chair-side stretching exercises may be more effective in the hand and wrist region, than in the body trunk.

The importance of ergonomic practice, including additional workshops or lectures, needs more continual follow-up throughout the education process in order to build good habits among dental hygiene students.[12,14,19,20,27,30] In contrast to other research studies, no significant differences were identified using the hierarchical regression model, regarding physical exercise and MSK pain, among the participants.[27,28,31] However, physical exercise was not controlled or included as a study intervention. Future studies may consider including an intervention of chair-side stretching, in combination with a specifically designed exercise program, to evaluate the effects on MSK pain reduction. All participants in this study had been required to purchase and use magnification loupes for patient care. Some research studies have shown that magnification loupes can improve posture for dental personnel, which may ultimately prevent or reduce MSK pain.[14,24–26] This may also have been a contributory factor to the lack of significance in the neck, shoulders, and low back pain severity scores. Changing or controlling this factor in future research could result in a different outcome.

This study had limitations. The sample population was small and from a single dental hygiene program. Also, in contrast to research by Peros et al., this study could find no differences in MSK pain associated with gender[31] as there was only on male student in the sample. However, given the predominately female demographic of the profession, it may not be necessary at this point in time to identify gender differences in response to treatment.[42] Future studies should include a larger and more gender diverse sample.

The length and complexity of the SNQ, which included multiple sections and repetitive content, may have been a barrier. Participants' self-reported responses might not have been consistent in relation to their experienced MSK pain. None of the participants were assessed by a physician for the purpose of this study and none had a documented MSD diagnosis. Future studies should consider including a medical examination to more accurately determine diagnosis of MSD.

Conclusion

The findings from this study suggest that consistent chair-side stretching regimen may be beneficial in reducing MSK pain, particularly within the hand and wrist region. While MSD are common among dental professionals, there has been little focus on MSK pain prevention and reduction strategies. Future research is needed to determine effective interventions to reduce MSK pain, particularly for the neck, shoulders, and lower back beginning during the dental hygiene education process to promote professional health and career longevity.

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