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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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Inside this Issue

Guest Editorial

Research

Issues and Innovations in Dental Hygiene Education

Research Posters

Guest Editorial

Health Misinformation: The Role of the Dental Hygienist in Providing Evidence-Based Information

Christine Nathe, RDH, MS

Health information has never been so accessible as it is today. Some of us are old enough to remember that you had to visit a library to find a reference book or periodical to research information on diseases and disorders. However, when the Internet became available to the public in 1993, both the creation and access to information was open to all. Add in the convenience the mobile devices that have become essential for activities of daily living, and it is easy to see the challenges in differentiating health information based on scientific evidence and health misinformation. As oral health care professionals, it is important for dental hygienists to understand basic scientific principles, be able to access accurate information, and ultimately share this knowledge in the delivery of patient care.

Understanding Research Principles

Dental hygiene practice is based on published research, which means that practitioners should make decisions based on scientific evidence rather than anecdotal tradition or personal preferences. However, to accurately interpret research and incorporate these findings, dental hygienists must understand basic research principles. Accreditation standards include the incorporation of research into the curriculum to prepare dental hygiene students with the necessary skills to understand and critically evaluate research. These skills are designed to lay the framework for evidence-based decision making as future health care providers.

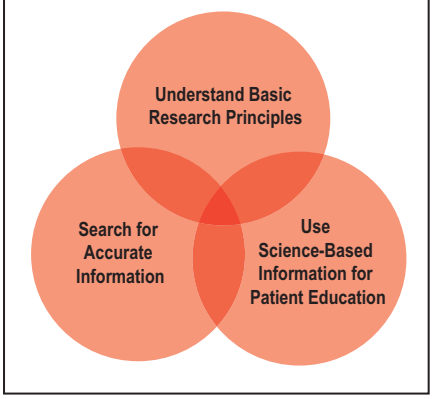
Searching for Accurate Information

The first step in using evidence in practice, is the ability to locate accurate information. While searching the Internet may be dental hygienists' first choice for answer a clinical question, health care providers need to be familiar with the resources available through vetted websites and search engines. Dental hygienists must also be familiar with the level of evidence and the importance of reported results from research studies. For example, a published case report will not have the same weight or significance as a randomized control trial, and a systematic review synthesizes the results from multiple similar studies. It is also important to review the sources and funding or sponsorship of the research for any potential bias in the study, critical skills for any consumer of health information.

Dental Hygienists as Health Educators

Our role as health educator emphasizes the need to provide accurate information to improve the health of our patients and the public. This role is even more critical considering the challenges of misinformation promoted during the current pandemic. The public health crisis aside, the range of dental care products available to the public has increased exponentially in recent years. As oral health care professionals, dental hygienists must be able to read and understand scientific reports to assist patients in discerning true evidence from false advertising claims. Patients have become active participants in their dental care, a transformation that has benefitted both the patient and the partitioner. Dental hygienists should take

Mitigating the Spread of Misinformation



advantage of the willingness of patients to seek out dental information, by helping them access accurate, evidence-based information.

Key take-away

Research plays a pivotal role in the advancement of the dental hygiene profession. While many of dental hygienists will never actively conduct research studies, all dental hygienists need to understand basic research concepts and be proficient in searching for factual, scientific information on oral health. It is important not be swayed by data that may sound valid but has significant design flaws and biased interpretations of the findings. Moreover, as health care providers, dental hygienists should have the communication skills to share evidence-based information with patients and the public.

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Research

Electromyographical Assessments of Recommended Neck and Trunk Positions for Dental Hygienists

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Abstract

Purpose: Dental professionals are recommended to limit neck and trunk flexion to within 20° of a neutral (0°) body posture, however empirical support for the recommendations is lacking. The purpose of this study was to determine whether there are differences in muscle workload between a range of neck and trunk postures in a population of dental hygiene students.

Methods: Fifteen first semester senior dental hygiene students with no history of neck and trunk injury volunteered to participate. Surface electromyography was used to record muscle activity from two neck extensors muscles, cervical erector spinae (CES) and upper trapezius (UT), and two trunk extensor muscles, thoracic erector spinae (TES) and iliocostalis lumboruni (IL). Participants performed ten conditions, including five neck flexion angles (0°, 10°, 20°, 30°, 40°) and five trunk flexion angles (0°,10°, 20°, 30°, 40°). For each trial, posture was checked with a goniometer and maintained for 20s. Muscle activity for each muscle was normalized to the individual's maximum voluntary isometric contraction (MVIC).

Results: Activity of the CES was significantly lower in the neutral position than all flexed neck positions. Activation of the UT increased with neck flexion but required 30° of flexion to differ significantly from the neutral position. Activity of the TES required 20° of trunk flexion to differ significantly from neutral and IL activity in the neutral position was significantly lower than all other trunk flexion conditions.

Conclusion: Even small amounts of neck or trunk flexion (10°), within the recommended range (≤ 20°), can significantly increase the workload for some muscles in an oral health care provider.

Keywords: ergonomics, posture, musculoskeletal disorders, dental hygienists, oral health care providers, occupational health

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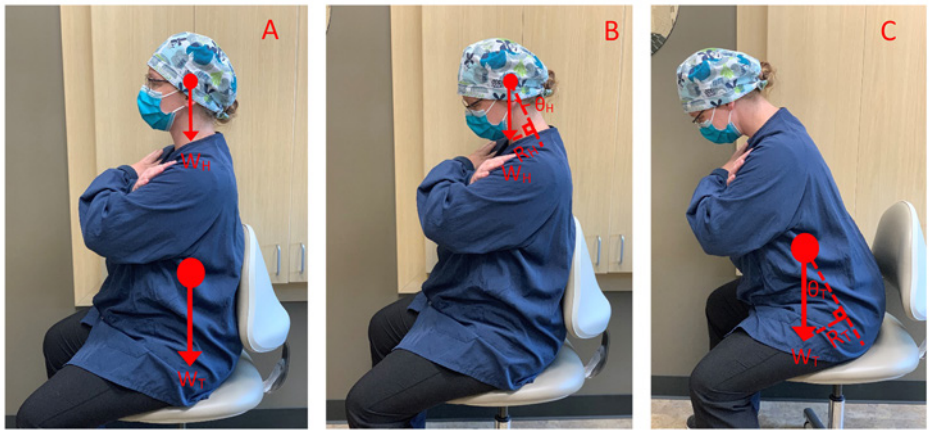
Introduction

The National Institute for Occupational Safety and Health (NIOSH) states that working environments that require awkward postures of the neck and back muscles place the employee at high risk for musculoskeletal disorders (MSDs).[1] Dental hygiene practice is physically demanding, often resulting in dental hygienists holding their neck and trunk in less than optimal positions for long periods of time while using high precision forces and performing highly repetitive motions.[2,3] Unfortunately, the high prevalence of work-related MSDs to the neck (54-69%) and back (24-67%) reported by dental hygienists confirms that the occupational requirements result in increased risk of MSDs.[4-6] These work related MSDs have a significant impact on dental hygienists in clinical practice, leading to reduced productivity or performance, and even to decreased working hours or the need to leave the profession.[7,8] In an effort to reduce MSDs, ergonomic instruction has been included in dental hygiene curricula and continuing education seminars.[9, 10] To reduce the incidence of MSDs of the neck and back, dental hygiene students are instructed to maintain both neck and trunk flexion between 0° and 20°.[11] While the efforts devoted to applying ergonomic principles within academia and dental hygiene clinical practice is to be applauded, these guidelines have received scant empirical examination. There is no evidence to indicate whether the current recommendations are in fact appropriate in preventing or reducing work-related MSDs in dental hygienists.

Recommending that the head and trunk remain close to an upright, neutral alignment is based on the mechanical principle of torques or force moments.[12] With the head and trunk in a neutral alignment, the force of gravity (weight) of the head (W_H) and trunk (W_T) act down the spine, creating no torques at the vertebrae of the spine (Figure 1A). Leaning the head forward moves the force of gravity outside of the spine, which creates a moment arm for the head (R_H, perpendicular distance between the joint axis and the line of force) resulting in a torque at the vertebrae in the neck (T_H) due to the weight of the head (Figure 1B). Similarly, leaning the trunk forward creates a moment arm (R_T) resulting in a torque (T_T) at the vertebrae in the lower back (Figure 1C). The more an individual leans, the greater the angle at the head (θ_H) or trunk (θ_T) and the larger the resulting torques.

Figure 1. Torques on the vertebrae of the neck and lower back due to neck flexion and trunk flexion.



Circles indicate the approximate center of mass of the head and trunk. Arrows represent the force of gravity vectors (weight) of the head (W_H) and trunk (W_T).

A: Approximately neutral alignment with the force vectors acting through the spine.

B: Demonstrates neck flexion (θ_H). The weight of the head produces a torque proportional to the perpendicular distance from the axis of rotation (R_H).

C: Demonstrates trunk flexion(θ_T). The weight of the trunk produces a torque proportional to the perpendicular distance from the axis of rotation (R_T).

To demonstrate the relationship between neck flexion angle and torque at the neck, the computed torques for a representative female and male in five different neck flexion positions, are shown in Table I. Human anthropometric data from an average woman and average man reported in De Leva were used for the calculations.[13] Table I shows that 0° of neck flexion results in no torque at the neck, but as neck flexion increases the torque at the neck increases. Similarly, Table II provides calculations of the torque at the lower back produced by flexion at the trunk, based on the same anthropometric data from the literature.[13] For these calculations the weight of the head also contributes to the torque at the lower back. Again, increased flexion results in increased torque. To maintain these postures, equal and opposite torques must be produced by the extensor muscles of the posterior neck and back, which places more stress on the vertebrae. It is also important to realize that due to the mechanical disadvantage of these muscles, the forces produced by the muscles are considerably larger than the forces produced by the weight of the head and trunk.[6] While a simple model has been used to highlight the effects of neck and trunk flexion, more complex models allied with experimental data can provide more detailed understanding of the internal forces on the vertebrae themselves.[14] Recommendations of not flexing the neck or trunk more than 20° suggests that humans can safely handle these torques for a period of time, however it is not clear how much work the muscles are actually performing and there is no empirical research to examine whether 20° neck and trunk flexion guidelines are appropriate.

Currently, the most accurate technique to quantify muscle workload is to record the electrical activity of the muscles through electromyography (EMG).[15,16] Electrodes placed on the surface of the skin over the belly of a muscle detect small voltages that occur from a summation of action potentials produced by motor units, which make up the muscle. Larger voltage indicates more motor units are recruited more frequently and is positively correlated to greater force production. Electromyography has proven to be a useful technique for assessing the application of ergonomic principles to the design of dental instruments. This technology has identified characteristics of scaling instruments and mirrors which reduce muscle loads, in addition to indicating that cordless polishing handpieces have been shown to reduce total muscle workload compared with corded handpieces.[17-21]

To date, ergonomic principles applied to recommendations for particular body postures during clinical dental hygiene practice and muscle workloads have received little attention in the literature. One exception was a study which revealed that use of one or two finger rest positions reduces workload of muscles of the hand and forearm during dental hygiene scaling procedures.[22] In the broader ergonomic research literature, there is little research which has assessed muscle activity under different sitting postures. Sitting with

Table I. Anthropometric neck torque (TH) computed for five different neck flexion angles (θ).*

θ (°)	Female				Male			
	[1]W_H (N)	[2]D_H (m)	[3]R_H (m)	[4]T_H (N.m)	W_H (N)	D_H (m)	R_H (m)	T_H (N.m)
0	40.6	0.12	0.00	0.0	49.7	0.12	0.00	0.0
10	40.6	0.12	0.02	0.8	49.7	0.12	0.02	1.1
20	40.6	0.12	0.04	1.6	49.7	0.12	0.04	2.1
30	40.6	0.12	0.06	2.4	49.7	0.12	0.06	3.0
40	40.6	0.12	0.08	3.1	49.7	0.12	0.08	3.9

*Data based on the average female (body mass = 61.9 kg, height = 1.735 m, head length = 0.2437 m) and average male (body mass = 73.0 kg, height = 1.741 m, head length = 0.2429 m) reported by De Leva.[13]

1 Weight of the head

2 Distance from the center of mass of the head to the axis of rotation

3 Perpendicular distance of the center of mass of the head to the axis of rotation

4 Torque at the neck due to the weight of the head and trunk

a flexed spine has been found to increase neck and shoulder muscle activity.[23] In contrast, "slump sitting" led to increased cervical erector spinae (neck) muscle activity, but lower thoracic erector spinae (upper back) activity as compared with upright sitting.[24] While these studies compared upright with flexed/slumped sitting, they did not compare different degrees of forward flexion, nor did they separately assess trunk and neck flexion on muscle activity throughout the back.

Dental hygienists have learned in their clinical education experiences to strive to maintain both a head and trunk flexion between 0° and 20°.[11] When the head or trunk is flexed, the extensor muscles of the neck and back are expected to be activated to hold the head or trunk in position against the torque produced by gravity and the muscle activity of the neck extensors (CES and UT) are expected to demonstrate increases with greater neck flexion. The purpose of this study was to examine the established head and trunk postural recommendations for dental hygienists using electromyography.

Methods

Participants

This repeated measures design study received full approval from the Old Dominion University Institutional Review Board. A convenience sample of fifteen dental hygiene students was recruited via an email invitation letter. A screening questionnaire was used to ensure participants were first semester seniors without a history of musculoskeletal disorders or surgeries to the neck and back. Participants were female ranging in age from 21.2 to 29.5 years. Informed consent was obtained from all participants prior to data collection.

Procedures

To test the recommended head and trunk flexions of between 0° and 20°, participants were asked to statically held a total of ten different postures, including five different neck flexion positions (0°, 10°, 20°, 30°, 40°) and five trunk flexion positions (0°, 10°, 20°, 30°, 40°). Pre-amplified surface EMG sensors (Delsys, Inc., Natick, MA,

Table II. Anthropometric lower back torque ($T_{H\&T}$) computed for five trunk flexion angles (θ)*

θ (°)	Female							Male						
	[1]W_H (N)	[2]D_H (m)	[3]R_H (m)	[4]W_T (N)	[5]D_T (m)	[6]R_T (m)	[7]$T_{H\&T}$ (N.m)	W_H (N)	D_H (m)	R_H (m)	W_T (N)	D_T (m)	R_T (m)	$T_{H\&T}$ (N.m)
0	40.6	0.73	0.00	258.5	0.31	0.00	0.0	49.7	0.72	0.00	311.2	0.31	0.00	0.0
10	40.6	0.73	0.13	258.5	0.31	0.05	18.9	49.7	0.72	0.13	311.2	0.31	0.05	23.0
20	40.6	0.73	0.25	258.5	0.31	0.10	37.2	49.7	0.72	0.25	311.2	0.31	0.11	45.3
30	40.6	0.73	0.37	258.5	0.31	0.15	54.3	49.7	0.72	0.36	311.2	0.31	0.15	66.3
40	40.6	0.73	0.47	258.5	0.31	0.20	69.9	49.7	0.72	0.47	311.2	0.31	0.20	85.2

[1] Weight of the head

[2] Distance from the center of mass of the head to the axis of rotation

[3] Perpendicular distance of the center of mass of the head to the axis of rotation

[4] Torque at the lower back due to the weight of the head and trunk

[5] Distance from the center of mass of the trunk to the axis of rotation

[6] Perpendicular distance of the center of mass of the trunk to the axis of rotation

[7] Torque at the lower back due to the weight of the head and trunk

*Data based on the average female (body mass = 61.9 kg, height = 1.735 m, head length = 0.2437 m) and average male (body mass = 73.0 kg, height = 1.741 m, head length = 0.2429 m) reported by De Leva.[13]

USA) were placed over four muscles: cervical erector spinae (CES), upper trapezius (UT), thoracic erector spinae (TES), and iliocostalis lumborum (IL). Prior to placement of each sensor the skin was prepared by shaving (if necessary) and rubbing with an alcohol wipe. After the skin had dried each sensor was attached via double-sided sticky tape. The CES sensor was placed 2 cm laterally from the cervical vertebrae four spinous process.[24] An anthropometric tape measure was placed between the posterior aspect of the acromion and the spinous process of cervical vertebrae seven. The UT sensor was placed immediately lateral to the tape.[24] The TES sensor was placed 5 cm lateral from the spinous process at thoracic vertebrae four.[24] For the IL, the EMG sensor was placed at the same level as lumbar vertebrae two and was aligned parallel to a tape held between the posterior superior iliac spine and the lateral border of the muscle at the 12th rib.[25,26] All sensors connected wirelessly to the EMG system and were controlled via a computer with an EMG software program and data was collected at 2000 Hz.

Prior to the experimental trials, each participant performed the maximum voluntary isometric contractions (MVIC) of neck extensor and trunk extensor muscles. This required maintaining a static position over a clinical treatment table while contracting muscles as forcefully as possible against a resistance provided by one of the researchers. Three MVIC trials of 3 seconds each were performed for the neck and trunk extensor muscles separately. The experimental trials were performed following the MVIC. Participants sat in a standardized body position with their arms crossed over their chest, so that their arms could not provide support to the body and shoulder fatigue from holding their arms up was minimized. At the start of each trial, participants were placed in a specific neck or trunk position by one of the researchers using a goniometer. The researchers monitored each participant to ensure the body posture was maintained during each 20 second trial. If the participant moved the trial was repeated. Three valid trials were performed at each of five neck flexion angles (0°, 10°, 20°, 30°, 40°) and five trunk flexion angles (0°, 10°, 20°, 30°, 40°). In an effort to minimize order effects, the order of neck and trunk flexion conditions was counterbalanced across participants, while the order of the flexion angles was randomized. Participants rested for 30 seconds between trials and 60 seconds between conditions to minimize fatigue. While additional rest was permitted if necessary, it was not requested by the participants.

Data analysis

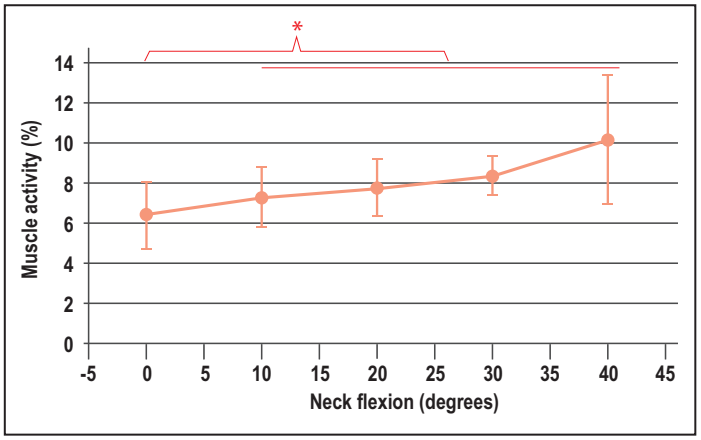
Raw EMG signals were processed using standard techniques, which were all performed using a computer software program (MATLAB version R2018b; Mathworks, Inc., Natick, MA, USA). First, the EMG signals were band pass filtered using 20-400 Hz cutoffs, then rectified. Each processed EMG signal was then integrated to obtain the area under the voltage-time curve, which provides a measure of total muscle activity. The average integrated muscle activity per one second was computed for both MVIC and experimental trials. Finally, EMG activity for each experimental condition was normalized to a percentage of MVIC (%MVIC), an approach that has been shown to be reliable and valid.[27,28]

One-way repeated measures analysis of variance (ANOVA) with the factor flexion was performed on the %MVIC data separately for the neck and trunk, and each muscle. Significant main effects were followed up with Sidak post hoc tests. All statistical tests were performed using a statistical software program (SPSS version 24; IBM, Armonk, NY, USA) and the level of significance was set at $p < .05$.

Results

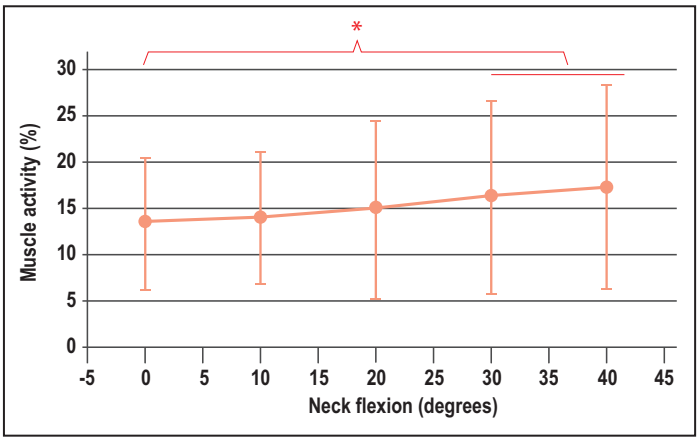
Both neck extensor muscles increased approximately linearly with increases in neck flexion (Figures 2, 3). Activity of the CES muscle activity increased, on average, from 6.2% of the MVIC at the neutral position (0° flexion) to 10.0% of the MVIC at 40° of neck flexion. ANOVA revealed that CES muscle activity differed significantly with changes in neck flexion position ($p<.05$). However, only the neutral position was significantly different from any of the other neck postures ($p<.05$), indicating that only 10° of neck flexion was needed for a significant increase in CES activation. The UT muscle increased activity from, on average, 13.2% to 17.1% of the MVIC. There was an overall significant effect of neck flexion angle on UT activity ($p<.05$). In this case, the neutral position was significantly less than 30° and 40° of neck flexion ($p<.05$). No other differences were significant for neck flexion.

Figure 2. Group mean activity of the cervical erector spinae (CES) muscle as a percentage of maximum voluntary contraction is plotted for five different neck flexion angles



Error bars indicate one standard deviation. The 0° neck flexion condition was significantly different from all other neck flexion conditions

Figure 3. Group mean activity of the upper trapezius (UT) muscle as a percentage of maximum voluntary contraction is plotted for five different neck flexion angles.



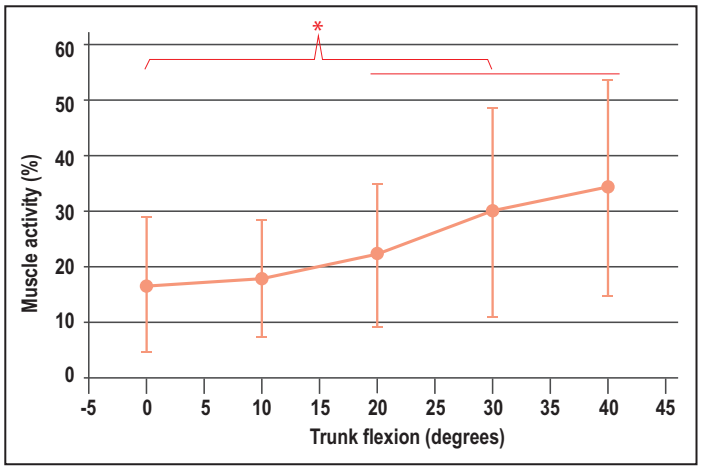
Error bars indicate one standard deviation. The 0° neck flexion condition was significantly different from the 30° and 40° neck flexion conditions.

Increases in trunk flexion resulted in an approximately linear increase in trunk extensor activity in both TES and IL muscles (Figures 3, 4). Thoracic erector spinae muscle activity increased with trunk flexion from, on average, 16.8% to 34.7% of the MVIC. The overall effect of trunk position had a significant effect on TES activity ($p<.05$). A neutral trunk position resulted in significantly lower muscle activity compared with 20-40° of trunk flexion ($p<.05$). No significant differences were found in muscle activity between 0 and 10° of trunk flexion or any other combination. The IL muscle increased activity from 8.9% to 18.6% of the MVIC with increasing trunk flexion, which was supported by a significant effect of condition ($p<.05$). The neutral trunk position resulted in significantly lower IL muscle activity compared with all other trunk postures ($p<.05$). No other postures differed significantly.

Discussion

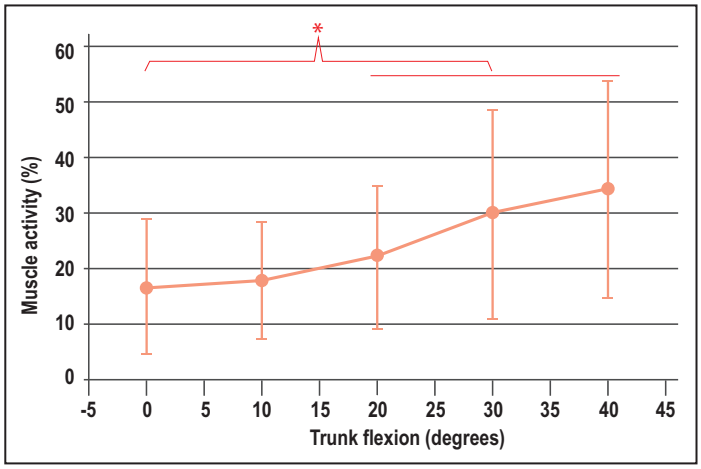
Dental hygienists suffer from a high prevalence of MSDs of the neck and trunk, indicating that many of these injuries are likely to be work related.[4-6] As clinical dental hygiene practice does not usually involve heavy lifting, it is likely that these injuries are related to awkward postures and movements adopted over significant periods of time each day.[1] Recommendations for maintaining head flexion between 0° and 20° and trunk flexion between 0° and 20° have been provided in an effort to prevent future MSDs.[11] These recommendations are taught in dental hygiene curricula in addition to professional workshops across the country. Minimizing neck and trunk flexion is based on the sound ergonomic principle of reducing the torque produced at vertebrae in the spine by the weight of the head and trunk.

Figure 4. Group mean activity of the thoracic erector spinae (TES) muscle as a percentage of maximum voluntary contraction is plotted for five different trunk flexion angles.



Error bars indicate one standard deviation. The 0° trunk flexion condition was significantly different from the 20°, 30°, and 40° trunk flexion conditions.

Figure 5. Group mean activity of the iliocostalis lumborum (IL) muscle as a percentage of maximum voluntary contraction is plotted for five different trunk flexion angles.



Error bars indicate one standard deviation. The 0° neck flexion condition was significantly different from the 30° and 40° neck flexion conditions.

However, there is no empirical evidence that up to 20° is an appropriate target. This study aimed to fill this void by quantifying the workload of extensor muscles of the neck and trunk which act to hold a flexed posture.

Results from this study provide limited evidence for recommending a neck flexion between 0° and 20°. In this study a neck flexion of only 10° resulted in a significant increase in muscle activity of the CES when compared with the 0° neutral position. For the UT muscle, 30° of neck flexion was required before a significant increase in activity when compared to the neutral position was detected. These results should not be interpreted as splitting the difference between

the significant effects, as the increased activity of the neck extensors combines, rather than cancels out. Figures 2 and 3 show that muscle activity of the neck extensors increased approximately linearly with greater neck flexion, which is in line with larger torques being created by the head at the spine with increased flexion angle (Table I). It should be noted that no sudden increases in activity in these muscles were found after 20°. Statistical significance indicates the difference in variation between posture conditions was considerably larger relative to the variation within postural conditions and should not be interpreted as an indicator of the risk of developing MSDs. A specific muscle workload to minimize MSDs is unknown, hence the results do not point to a maximum neck flexion range. However, these results show that even 10° of neck flexion significantly increases activation for at least one of the two muscles tested.

Similar to the findings for neck flexion, this study did not provide evidence to support the recommendation of maintaining trunk flexion between 0° and 20°. Only 10° of trunk flexion from neutral was necessary to lead to a significant increase in IL muscle activity, and at 20° of trunk flexion the TES muscle activity was significantly greater than in the neutral position. Figures 4 and 5 demonstrate that trunk extensor muscles increase in an approximately linear fashion with greater trunk flexion, without any abrupt change in activity after 20°. Rather than finding evidence for the 0-20° trunk flexion recommendation, trunk extensor muscle activities were observed even within this small range of movement.

Recent research shows that dental hygienists often exceed even the recommended limit of 20° of neck or trunk flexion. Average neck flexion during instrumentation (exploring) was observed to be over 30°, while average trunk flexion of 19° indicates that much of the time was spent close and beyond the limit.[26] Similarly, average neck flexion while scaling was 25° and trunk flexion was 19°.[29] While many dental hygienists are aware of the importance of posture in reducing the risk of MSDs, it seems difficult to deliver clinical care while maintaining appropriate body position. Exploring, scaling and polishing require visualizing the tooth surfaces. Clinicians can adjust the patient position, the operator stool, and use a mirror and magnification loupes. However, even with all these strategies, it can be challenging to see the tooth surface while maintaining a neutral neck and trunk position.

Magnification loupes have been promoted as an ergonomic solution; however, evidence has been mixed. While the use of loupes did not result in significant improvements in neck or trunk flexion during exploring, they have been found to reduce trunk flexion during scaling procedures.[26,29] Interestingly, dental hygienists have the perception that the use of magnification improved their posture even when the data revealed no differences.[28] This apparent misperception of neck and trunk flexion during dental tasks maybe also be a significant factor in the difficulty of maintaining ergonomic posture. It may be more efficacious to aim for a neutral alignment of neck and trunk rather than not exceeding a limit. Future research is necessary to determine if a neutral alignment of neck and trunk can be achieved during dental hygiene tasks and how it is best supported by education and technology.[10]

This study had two main limitations. It was designed to maximize internal over external validity. Participants adopted and held static postures without performing a dental hygiene task. This had the benefit of enhancing the experimental comparison between the different postures, however, practicing clinicians perform different tasks while holding different postures. It is anticipated that performing tasks at the different postures would likely increase the difference in muscle activity between neck and trunk flexion angles. Flexing the head while flexing the trunk is expected to increase torques as the moment arm is even further from the fulcrum at the back. Similarly, using ultrasonic and hand instruments to explore, debride, scale or polish would likely further amplify torques at the trunk depending on trunk flexion posture. Having participants maintain particular neck or trunk flexion angles while practicing clinically would reduce the fidelity of the experimental conditions but could be examined in future research.

The second main limitation of this study is that the muscle workloads that result in MSDs are not known. There are several reasons for this knowledge gap. First, MSDs develop from a combination of intensity, duration and frequency of load. Injury can occur due to a single very large load, or small loads over time with repetition. Second, there are significant variations in anatomy and the ability to withstand different kinds of loads, which in turn can vary within the clinician's body. Third, quantifying muscle activity using EMG provides a relative rather than an absolute measure of muscle workload because the electrical signal can be influenced by the placement of the electrodes, preparation of the skin, as well as the degree of adipose tissue overlying the muscles. However, EMG does provide a means to compare the activity levels between experimental conditions (when the electrodes remain in position) to determine what leads to differences, and computing values as a percentage of MVIC provides a useful metric and reduces between individual variation. Currently, EMG provides the best approach to quantifying muscle workload and identifying conditions more likely to

increase MSDs. Future research could combine EMG data with modeling of the spine for more detailed understanding of the internal forces on the vertebrae and other structures.[14]

Even with these limitations, results from this study demonstrate that clinicians should minimize the time spent with the neck or trunk flexed away from the neutral position. Even 10° of neck or trunk flexion significantly increases activity of at least one neck or trunk extensor muscle, respectively, and this stress can be compounded over time. The published recommendation that dental hygienists maintain neck and trunk flexion between 0° and 20°, would be expected to reduce the risk of MSDs, however, there is no evidence that maintaining up to 20° of neck or trunk flexion for long periods of time is a safe guideline. Furthermore, despite the ergonomic recommendations made in curricula and workshops, dental hygienists continue to report a high incidence of work-related MSDs.

Conclusion

Even small degrees of neck and trunk flexion (10°) from a neutral position result in significant increases in activity of neck and trunk extensor muscles, respectively. While the particular muscle workload that likely leads to MSDs is unknown, the fact that dental hygienists report a high prevalence of neck and back MSDs indicates that the occupation is placing stress on those areas. Minimizing time spent in a position with the neck or trunk flexed should reduce the risk of MSDs. Further research is needed to provide successful strategies for helping dental hygienists to reduce MSDs to the neck and back which can have significant effects on the health and career of clinicians.

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Research

Oral Health Education and Promotion Activities by Early Head Start Programs in the United States: A systematic review

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Abstract

Purpose: Dental caries is a non-communicable, preventable disease that disproportionately affects low-income children in the United States (US). The purpose of this systematic review was to describe oral health education and promotion activities designed to prevent early childhood caries (ECC) provided by Early Head Start (EHS) programs in the United States.

Methods: Five databases were searched including CINAHL, Dentistry & Oral Sciences Source through EBSCO, PubMed, Google Scholar, and the Wiley Online Library, to identify peer-reviewed quantitative studies published in English on oral health education and promotion activities within EHS programs from 2000 to 2019. Studies were assessed for eligibility using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram (PRISMA). Two researchers independently evaluated the included studies.

Results: The initial search yielded a total of 363 articles. Following the screening process, five studies met the inclusion criteria (observational, n=2; quasi-experimental, n=3). The main outcome measures included oral health knowledge, attitudes and behaviors, oral health education, oral health promotion, and oral health activities. Three studies investigated the effectiveness of oral health education and promotion interventions among EHS staff and parents. Two studies examined oral health activities such as education, toothbrushing instructions, toothpaste use, dietary education, and dental assessment.

Conclusions: Studies that focused on increasing pediatric oral health knowledge and practice behaviors among both EHS staff members and parents reflected positive outcomes. Ongoing research is needed to examine the effectiveness of oral health education and promotion activities as they relate to the oral health outcomes of children enrolled in EHS programs.

Keywords: early childhood caries, health promotion, oral health prevention, public health, systematic review

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Introduction

Early childhood education programs in the United States (US) are supported with grants and services, such as educational planning, development, evaluation, and quality assurance from the US Department of Education in partnership with the US Department of Health and Human Services.[1] Early childhood prevention programs, such as Head Start (HS), Early Head Start (EHS), Women, Infants, and Children (WIC), and home visiting provide a variety of oral health promotion and education activities for families and children, and provide assistance in navigating health and dental services.[2,3] In addition, HS/ EHS programs introduce children to school through the implementation of a goal oriented approach to enhance positive outcomes for children and families.[4] Head Start programs are federally funded and provide education, health, and family well-being services for low-income children age 4 to 5 years.[5] Children from birth to age 3 years and pregnant women from low-income families are served by EHS programs.[6] In the year 2000, there were 1700 HS/EHS programs that provided services via the HS center-base, home-base, or family child care model.[5]

Oral health policies and standards for the HS/EHS programs are provided through the US Department of Health and Human Services, Office of Head Start, with the assistance of partnerships from professional oral health organizations.[6] Oral health performance standards include regulations related to tooth brushing, feeding practices, fluoride use, first dental visit, and oral health education and promotion activities.[6] In 2018-2019, a total of 166,693 children were enrolled in EHS

programs across the US.[7] Data collected from an inner-city childcare center in New York (2004-2006) showed that 43% of the children enrolled in EHS (n=162) had at least one carious lesion.[8] Further, data collected during 2011-2014 showed that 9.14% of children in the US aged 0-5 years had untreated dental caries.[9] In general, children enrolled in EHS programs[8] and those from families with parental poverty and low health literacy, tend to have a higher risk for dental caries.[10]

Dental caries is a preventable disease that disproportionately affects low-income children.[10,11] Specifically, early childhood caries (ECC) involves children <6 years old with a dental caries experience.[11] Organizations such as the American Academy of Pediatrics (AAP), American Academy of Pediatric Dentistry (AAPD), American Dental Association (ADA), and American Dental Hygienists' Association (ADHA) emphasize the importance of oral health education to improve oral health status and overall quality of life for children.[12-15] It is important to understand the oral health education and promotion activities EHS programs are implementing resulting from the recommended oral health standards. Examples of oral health education may include incorporating learning activities within the classroom and providing oral health information to parents and caregivers. Oral health promotion activities may include integrating toothbrushing and dental screenings within EHS programs.[6] Early Head Start staff members have been shown to value children's oral health and exhibit interest in providing learning activities; however, inadequate oral health knowledge has been shown to minimize their confidence to develop preventive activities.[16,17] The purpose of this systematic review was to address the question, "What oral health education and promotion activities are performed in EHS programs for staff, children, and caregivers in the United States?"

Methods

Search strategy

An initial search was conducted February 2019 by the primary investigator using five data bases: CINAHL Plus with Full Text, Dentistry & Oral Sciences Source through EBSCO, Medline through PubMed, Google Scholar, and the Wiley Online Library. Various combinations of keywords were used in the search. Search terms included: [oral health OR dental health OR oral hygiene OR dental hygiene AND education OR promotion OR activities OR tooth brushing AND Early Head Start AND Early Childhood Caries OR dental caries OR tooth decay OR cavities]. Other keywords included specific oral health activities for children, among them: "mouth cleaning, fluoride use, bottle use, first dental visit, and dental referral." The specific population reference words included: "staff, directors, children, and parents." Once the database search was completed, an individual search was performed utilizing the reference lists of the included studies. After the search was conducted, a second investigator screened the list of search terms and article returns based on the research question. A reference management software program (Mendeley version 1.19.3; London, UK) was used to identify duplicates, and to organize abstracts.

Eligibility criteria

Inclusion criteria for the systematic review were quantitative peer-reviewed experimental and observational studies, conducted in the US, and written in English between 2000-2019. Specifically, studies that examined oral health activities, oral health education, and oral health promotion in Early Head Start programs were included in the search strategy. Studies were excluded if they were qualitative, letters to the editor, case reports, personal communications, or narrative reviews.

Study selection

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart was used for the systematic review.[18] In the first step, duplicate studies were removed, and the remaining studies were screened by titles and abstracts independently by the primary and secondary reviewers. Second, full text articles were assessed for eligibility. Lastly, articles that met the inclusion criteria were reviewed by the primary reviewer followed by the second reviewer.

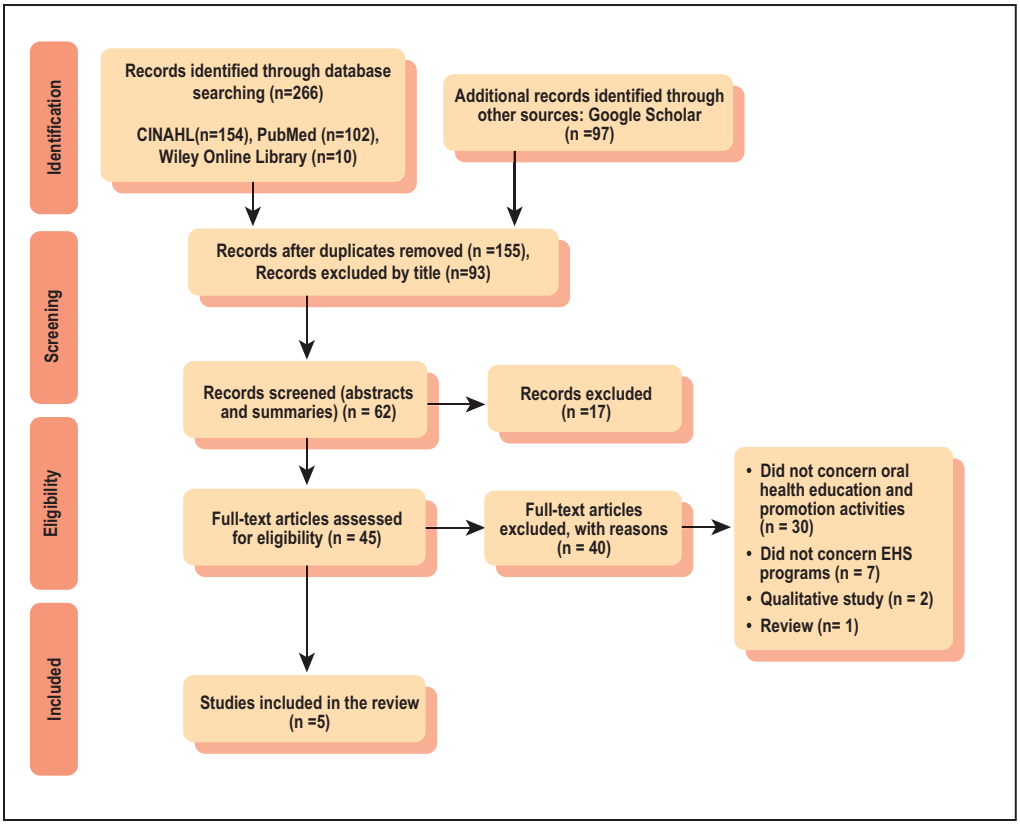
Risk of bias in individual studies

The quality of included studies was assessed by two reviewers, who independently evaluated the quality of studies using the Effective Public Health Practice Project's Quality Assessment Tool.[19] The tool consists of eight components that evaluate selection bias, study design, confounding variables, blinding, data collection methods, withdrawals and dropouts, intervention integrity, and analyses.[19] Each of the eight components have questions with multiple choice answers that are scored according to a specific criteria and described as good, fair, or poor. Next, an overall global rating was developed for each component to include strong, moderate, and weak. At the end of the article review, a rating was determined for the overall quality of the study. Rating criteria were strong (the article received no weak ratings), moderate (one weak rating), or weak (two or more weak ratings). If there was a discrepancy with an article rating due to an oversight or differences in interpretation of criteria, the reviewers discussed the article to reach a consensus. The five articles were summarized according to the author and year, study location, research design, population, outcome measure, and significant results.

Results

A total of 363 search results were obtained from the electronic database search. After duplicates were removed, 155 articles remained and of those, 93 were excluded based on the titles, 17 were excluded after screening the abstracts. The remaining 45 articles were included in full-text screenings; of these, 40 were removed based on the exclusion criteria. A total of five articles met the inclusion criteria for this review. Ratings for the five articles were as follows: high (n=1), moderate (n=3) and weak (n=1). The PRISMA flow-chart is shown in Figure 1.

Figure 1. Four-phase preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow-chart of identified articles18 (n=266)



Study characteristics

The five articles included were observational studies (cross-sectional, n=2; quasi-experimental n=3). Two studies were conducted in North Carolina, one in New York, one on the Hawaiian island of O'ahu, and one in Wisconsin. Study participants included EHS directors, teachers, and health coordinators (n= 485),[17] Migrant and Migrant Seasonal Head Start Program (MSHS) staff (n=401),[20] and EHS staff members who interacted directly with children and parents (n=71),[21] parents of children enrolled in EHS programs (n= 91),[23] and EHS home visitors (n=118).[22] Outcome measures used within the five studies included: oral health knowledge and attitudes, oral health activities, self-efficacy, readiness to perform oral health promotion, and promotion of dental care use. For this systematic review, the outcome measures were organized into three categories: oral health knowledge, oral health promotion, and oral health activities. A summary of the included studies is shown in Table I.

Oral health knowledge

Glatt et al.,[22] Kranz et al.,[17,20] and Wilson et al.[23] examined oral health knowledge of EHS home visitors, parents, and staff members (program directors, teachers, and health coordinators) using self-administered questionnaires. Two of these studies used interventions, educational videos and motivational interviewing, with the aim to increase knowledge of the participants.[22,23] Glatt et al. demonstrated improvement in oral health knowledge of EHS staff members,[22] while Kranz et al. noted a gap in the oral health knowledge of EHS teachers.[17,20] Wilson et al. revealed improved knowledge among parents after receiving oral health education videos intervention, as demonstrated by increased correct answers from baseline (72%) to posttest (81%).[23]

Glatt et al. focused on home visitors (n=118) who received a 3 hour educational session including a video that provided motivational interviewing techniques.[22] The short-term impacts of the intervention increased home visitors' oral health knowledge by 7-29% on 5 out of 14 questions ($p<0.05$).[22] Kranz et al. examined pediatric oral health knowledge and activities of EHS staff members (e.g. directors, teachers, and health coordinators) in two studies.[17,20] A dental visit for children by age one is emphasized by the Head Start Early Childhood Learning and Knowledge resource center.[24] However, 47.69% of EHS teachers (n=260) reported knowing about the recommended dental visit by age one compared to 61.11% of EHS program directors (n=18), and over 50% of health coordinators (n=18).[17] Over 80% of EHS teachers reported knowing that low-income children have an increased risk

Table I. Summary and characteristics of included studies (n=5)

Author	Study Design	Intervention	Participants	Control group	Outcome Measures	Significant results
Kranz, A. et al. (2011)	Cross-sectional	No intervention	EHS teachers, directors, & health coordinators (home based & center based) in North Carolina.	No control group	Child activities Parent-directed activities	Sum of oral health activities responses to a 0-4 Likert-type scale (never to very frequently), with teachers having mean scores of 6.87 for parent activities and 9.03 for child activities.
Kranz, A. et al. (2012)	Cross-sectional	No intervention	Migrant and Migrant Seasonal Head Start Program (MSHS) staff who work with children 3 years old & younger in North Carolina	EHS teachers, directors, & health coordinators (home based & center based)	Brushing related activities Parent-focused oral health activities	Most teachers had children brush their own teeth. Compared to EHS staff, MSHS staff provide more classroom education and parent's advising about child's oral health. Both MSHS & EHS staff are more likely to engage in brushing activities in classroom than in parent-directed oral health activities.
Chinn, CH. et al. (2011)	Pre and post with intervention	Columbia Head Start Oral Health Program (C-HSOHP)	HS & EHS staff members engaged in direct and regular interaction with families from 4 participating C-HSOHP program in New York City	No control group	Overall oral health status of children Frequency of dealing with oral health issues Attitudes regarding pediatric oral health Perceived difficulty, self-efficacy, and readiness to oral health promotion.	No differences between pre- and post-C-HSOHP surveys in HS/EHS staffs perceived influence on improving children's oral health. C-HSOHP improved HS/EHS staff attitude and perceived confidence in advising parents on pediatric oral health issues and dental services.
Wilson, L. et al. (2013)	Quasi experimental	Two oral health education videos: didactic video (Baby's Oral Health) and family-centered video (Baby's First Smiles)	Parents of children enrolled in one of two EHS programs serving rural areas of the island of O'ahu and Hawai'i	No control group	Oral health knowledge, attitudes, and behaviors Change in nutrition habits, oral health routines, and dental visits Consumer satisfaction	Parents' oral health knowledge, attitudes, and behaviors scores significantly increased from pre-test to post-test. At post-test, no significant group difference in knowledge scores. Baby's First Smiles group showed higher scores for oral health attitudes and behaviors at post-test.
Glatt, K. et al. (2016)	Pre and post with intervention	3-hour educational session: oral health knowledge and motivational interviewing	Wisconsin EHS home visitors	No control group	Oral health related knowledge Confidence in advising about oral health	Significant improvement in short-term knowledge about fluoride, dental caries process, supervising children's tooth brushing. Significant improvement in confidence in advising about oral health at post-test.

for tooth decay.[17] Kranz et al. (2012) compared oral health knowledge and activities of EHS and Migrant and Seasonal Head Start (MSHS) programs staff members.[20] Of these, 79.6% of EHS teachers (n=329) and 70.8% of MSHS teachers (n=72) reported knowing that low-income children have an increased risk for tooth decay.[20]

Unlike the previous studies that focused on EHS staff members, Wilson et al. focused on the oral health knowledge of parents (n=91).[23] The researchers used two intervention approaches and randomly assigned parents and caregivers to one or two video groups: didactic in a lecture format or family-centered in a personal interview format.[23] Participants' overall mean oral health knowledge score increased significantly by 1.79 points (before intervention M=15.19, SD=3.43; after intervention M=16.98, SD=3.42).[23] However, there was no statistically significant difference between the groups in post-test knowledge scores based on the type of video received (didactic versus family centered).[23]

Oral health activities

Of all the studies reviewed, only two examined oral health activities in EHS program.[17,20] These studies assessed the numbers of oral health activities performed by EHS and MSHS teachers, using self-administered questionnaires.[17,20] Activities were divided into two categories, according to whether they were directed towards children or parents.[17,20] Children activities included toothbrushing, toothpaste use, and classroom education.[17,20] Parents' activities included oral health education and promotion in addition to assessing children's' dental needs and parents' oral health. [17,20] The studies also assessed perceived oral health self-efficacy and barriers to performing oral health activities by staff members.[17,20]

One study compared oral health activities performed by EHS teachers with those performed by MSHS teachers.[20] Fewer than half of EHS teachers (n = 260) were engaged in parent-focused activities as compared to more than 60% of MSHS teachers (n=72).[20] Children-focused activities were highly reported for both EHS and MSHS programs with higher percentages of brushing related activities in MSHS program compared to EHS program.[17,20] Both EHS and MSHS teachers were more likely to report the children brushing their teeth independently compared to assisting the children with toothbrushing.[20] The results also indicated that 74% of MSHS teachers provided classroom oral health education compared to 45.2% of EHS teachers.[20]

Among barriers cited for performing parent activities, EHS teachers demonstrated the highest lack of knowledge regarding fluoride use.[17] The most frequent barriers reported by EHS teachers for performing children activities included inadequate oral health education resources and knowledge regarding oral health activities.[17] For EHS directors and health coordinators, difficulty in locating dental professionals willing to provide dental services for children younger than three and accepting Medicaid insurance reimbursement, were the most frequently cited barriers for performing oral health activities.[17]

Oral health promotion

Chinn evaluated the effectiveness of an oral health promotion intervention program on oral health knowledge and confidence of HS/EHS staff using a self-administered survey before and after the implementation of the Columbia Head Start Oral Health Program (C-HSOHP).[21] The intervention program consisted of oral health education and training to include dental screenings and assistance with referrals to dental services.[21] Chinn found that a majority of the staff members (n=61) believed that oral health training and dental screenings were effective in improving children's oral health.[21] In addition, HS/EHS staff members' perceived self-confidence in communicating with parents and oral health professionals regarding children's oral health both increased from pre- to post- surveys by 15% and 20%, respectively.[21] Furthermore, dental referrals among staff members improved after the C-HSOHP by 20%, however there were no significant differences in identifying oral health issues, dental pain, and the overall oral health status of children.[21]

Discussion

Early Head Start children are considered high risk for developing ECC due to familial and environmental factors.[10] Preventive oral health activities within EHS programs can be beneficial in providing education and promoting healthy oral habits for children and their families.[25] Effective oral health education programs that target children, parents, and caregivers have improved oral health knowledge and reduced the disease prevalence among children.[26] Literature demonstrates that it is more effective to provide oral health education through promotional activities for preventing oral diseases.[25,26]

To the best of the authors' knowledge, this is the first systematic review to examine oral health education and promotion activities within EHS programs. The review revealed only five studies that examined oral health education and promotion activities in EHS programs and these studies were observational or quasi-experimental.[17,20-23] Three of the five studies focused on evaluating oral health education and promotion interventions,[21-23] while two studies directly assessed oral health activities in EHS.[17,20] In most studies,

researchers controlled for confounders, such as participants' level of education and oral health knowledge.[17,20-23]

Evidence on the effectiveness of oral health education interventions was demonstrated in two studies that received a strong or moderate overall quality scores by the raters.[22,23] In spite of the limitations with these studies, including small sample sizes and lack of follow-up of long-term effects, the results revealed that oral health education interventions in EHS are effective in increasing pediatric oral health knowledge among both staff and parents.[22,23] Oral health activities were assessed in two studies with moderate overall quality scores and revealed a low number of oral health activities within EHS programs.[17,20] In the Head Start Oral Health Project evaluation report of 2001 – 2008, it was recommended that more oral health educational resources be made available to all HS programs and more importantly that collaboration with dental hygienists is needed to support oral health activities within EHS.[25]

Oral health promotion was investigated in one study that utilized a community oral health training grant program in HS/EHS to improve pediatric oral health knowledge of staff members and parents.[21] In addition, the program provided children with dental screenings and assisted with dental referrals.[21] Although, the results demonstrated significant differences in pediatric oral health knowledge and competence among HS/EHS staff members, data was not presented on the children's oral health before and after the intervention program.[21] The study received a weak overall quality score due to insufficient control of confounders, social desirability bias, and unclear validity of data collection instrument.[21]

Limitations of this systematic review include a small number of studies that met the inclusion criteria and there were no randomized control designs identified. Furthermore, none of the included studies provided data on children's oral health outcomes resulting from the interventions implemented among EHS program directors, teachers, health coordinators, and parents.[17,20-23] Despite these limitations, this review provides information on oral health education and promotion activities within EHS programs that resulted in improved oral health knowledge among parents, and EHS directors, teachers, and staff members. These studies can be used as a framework to develop and evaluate future oral health education and promotion activities for EHS programs. Furthermore, the need is recognized for investigating and reporting oral health outcomes of EHS enrolled children as a future research direction.[21]

Dental hygiene implications

The American Dental Hygienists' Association (ADHA) encourages the promotion of oral health among low-income children and families through expanding the dental hygiene scope of practice to include their participation in community oral health programs.[27] Head start and EHS programs provide an opportunity for oral health care professionals to conduct education programs and promote interventions in to reduce the risk of ECC among young children.[23] Results of the studies included in this literature review revealed improved oral health knowledge of EHS staff members, parents and caregivers resulting from oral health education and promotion interventions.[22,23] Dental hygienists have a key role to play in promoting oral health and preventing ECC among children participating in EHS.[2] The Dental Hygienist Liaison Project (DHL), a partnership between the National Center on Early Childhood Health and Wellness and the ADHA, was formed to promote oral health among HS enrolled children, parents and staff members.[29] The project provides oral health education and increases children's access to dental services by connecting the HS community with dental hygiene education programs and dental professionals.[29] However, only a limited number of dental hygiene education programs have partnered with HS/EHS to provide dental hygiene services for children.[30,31] Dental hygiene education programs that have collaborated with HS/EHS programs have provided dental screenings and prophylaxis for children in addition to oral health education for children and parents.[30,31]

In addition to working with HS/EHS programs, there are opportunities for dental hygiene students to provide oral health education and dental hygiene care for pre-school aged children through community outreach and service-learning endeavors. Claiborne et al. implemented an innovative, collaborative service-learning activity that was provided by dental hygiene and primary care nurse practitioner students, with a focus on oral health education and dental screenings for pre-school aged children.[32] The program demonstrated a positive experience for the pre-school aged children and provided an interprofessional education experience for dental hygiene and primary care nurse practitioner students.[32] Dental hygiene education programs and practicing professionals who collaborate with HS/EHS programs can provide essential dental hygiene services to children and increase access to oral health care.[30,31]

Conclusion

A limited number of studies have examined oral health education and promotion activities for EHS staff members and parents. Studies that focused on increasing pediatric oral health knowledge and practice behaviors among EHS staff members and parents revealed improved oral health knowledge and behaviors. Ongoing studies are needed

to examine the effectiveness of oral health education and promotion interventions within EHS programs. Impacts of oral health education and promotion interventions on children's oral health also warrant examination in EHS programs. Collaboration with dental hygienists and dental hygiene education programs can support the oral health education and promotion activities of EHS programs and positively impact pediatric oral health and access to oral care.

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Research

Oral Health Knowledge, Acculturation and Utilization of Oral Health Services among a Hispanic and Latino Population

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Abstract

Purpose: Health disparities in the United States (US) are widespread, especially among racial and ethnic minorities populations. The purpose of this study was to assess whether oral health care knowledge and acculturation were associated with utilization of oral health services among the Latino and Hispanic population in Massachusetts.

Methods: A cross-sectional survey research design was used with a convenience sample of Hispanic or Latino adults (n=315) residing in Massachusetts. The survey consisted of three validated instruments: New Oral Health Literacy Instrument for Public Health, the American Dental Association's Health Policy Institute survey, and the Short Acculturation Scale for Hispanics survey (SASH). Oral health utilization was assessed using descriptive statistics, relationships between variables were assessed using t-tests.

Results: The survey had a completion rate of 73% (n=230). Participants with dental insurance had a higher mean number of correct oral health knowledge responses as compared to those without insurance (p=0.003). Females and participants who were married or in a civil union had a higher mean knowledge score. Participants with dental insurance were more likely to have visited the dentist in the last 12 months, and have a dental home compared to those without (p<0.001). These participants were also more likely to indicate they would visit the dentist in the next 12 months (97%, n=175). The mean SASH score was statistically significantly lower for participants without a dental home (p=0.03), without dental insurance (p=0.01), without a dental visit in the last 12 months (p=0.05), and for those not intending to visit the dentist in the next 12 months (p=0.01).

Conclusion: Improving access to affordable dental coverage, promoting the establishment of a dental home, encouraging cultural sensitivity among the dental team, and providing resources to those with limited English proficiency could improve utilization of oral health services among Latino and Hispanic populations.

Keywords: dental utilization, health disparities, minority health, oral health knowledge, access to care, population health

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Introduction

Health disparities in the United States (US) are widespread, especially among racial and ethnic minorities populations.[1] In 2017, the US Department of Health and Human Services (HHS) published the National Healthcare Quality and Disparities Report, in which various quality measures were examined, such as access and quality of health care, including processes of care, outcome of care, and patient perception of care. In nearly three-fourths (70%) of the measures examined, Hispanic populations experienced lower access to care when compared to non-Hispanic Whites. Hispanic populations were also more likely to be uninsured, with18.9% lacking health insurance as compared to 6.5% for non-Hispanic Whites.[2]

Evidence of disparity has been visible across several health care services, including oral health.[3] The Hispanic community is the largest ethnic/racial minority group in the US with a high burden of oral health disease.[4,5] Research has shown that Hispanic ethnicity is associated with poorer self-reported oral health quality of life (OHQOL).[6] Hispanic respondents in a study by Lugo et al. were more likely to have misperceptions

about oral health diseases and oral health in general than the general population.[4] Hispanics are more likely to schedule a dental visit as a result of pain, rather than on their own for routine preventive care.[7]

Oral health knowledge, an important component of health literacy is a potential factor in health disparities among the Hispanic and Latino population. Health literacy is defined as the ability to articulate, comprehend, and use information in order to make well-informed health-related decisions as they apply to oral health care.[8,9] In a landmark report, the Institute of Medicine affirmed that "health literacy remains a neglected, final pathway to high-quality health care."[10] Health literacy is more than being able read health related material, it is a complex combination of skills that includes writing, numeracy, listening, speaking, and conceptual knowledge of the specific health topic.[10] Groups that are more likely to have limited health literacy include non-White racial and ethnic groups, recent refugees and immigrants, people with less than a high school degree or GED, those with incomes at or below the poverty level and non-native English speakers.[11] Participants with limited oral health literacy levels have been shown to have poorer oral health.[12] If oral health disparities among the Hispanic and Latino population are to be addressed, it is important to examine factors that impact oral health knowledge and health literacy.

Acculturation, the process of adapting to new cultures and customs, is another factor in oral health disparities.[13,14] This relates to immigrants learning and incorporating the values, beliefs, language, customs and behaviors, including those that affect health, of the host country; the more that is incorporated, the more acculturated the individual becomes.[13,14] A review of literature from Betancourt et al., found that minorities, especially those with limited English proficiency, encountered sociocultural barriers at the organizational, structural and clinical level in health care, which contribute to racial and ethnic health disparities.[15] Cultural and linguistic barriers in the clinical encounter can negatively affect communication and trust, which impacts patient satisfaction, compliance and lead to poorer health outcomes.[15] When providers fail to take social and cultural factors into account, there is a risk of resorting to stereotyping, which may affect the providers behavior toward the patient and clinical decision-making.[15]

Many factors are known to contribute to or are associated with racial and ethnic disparities in health care.[3] Learning about the specific factors impacting Hispanic and Latino populations can help researchers develop solutions to meet their oral health needs.[4] Current research has found the lack of a dental home, low income, low education, and lack of insurance coverage were all barriers to dental utilization, [7,13,16] which has been defined as the percentage of the population who access dental services over a specified period of time.[17] The action of making practical and effective use of dental services is essential in maintaining overall health and well-being.[18] More specifically, a consistent pattern of routine dental visits is a necessary addition to an adequate self-care routine in the pursuit of good oral health.[18]

The state of Massachusetts has a health insurance mandate, stating residents must have minimum coverage to avoid paying a penalty to the Department of Revenue.[19] The Massachusetts Mandated Health Insurance Law states residents earning less than 300% of the federal poverty level (FPL) may access subsidized health insurance through the state Medicaid program, which may include dental coverage for individuals who qualify.[20] It is important to note that the state mandate does not explicitly require dental coverage for adults.[20] State residents who are ineligible for health insurance through their employer may also purchase low-cost insurance through the Health Connector.[21] Massachusetts leads other states in insurance coverage, with 96.3% of residents covered compared to 91.2% nationally.[22] However, with regard to the Hispanic population in the state, Massachusetts is failing to achieve benchmark quality measures in 15 out of 17 measures.[21] In a state where health insurance, one of the more common barriers for utilization, is removed for many residents, understanding what other factors impact oral health disparities among the Hispanic community could prove valuable to researchers, health care professionals, and policy makers as they work to manage the needs of this growing population. The purpose of this study was to assess whether oral health care knowledge and acculturation are associated with utilization of oral health services among the Latino and Hispanic population in Massachusetts.

Methods

A cross-sectional survey research design was used with a convenience sample of adults in Massachusetts who self-identified as Hispanic or Latino. This research was approved and awarded exempt status by the MCPHS University Institutional Review Board (protocol # IRB110519B). The survey was open to the entire state, however recruiting focused in and around three major cities in Massachusetts. Boston has a population 694,583 with 134,749 identifying as Hispanic or Latino.[23] The second largest city is Worcester, with a population of 185,877, with 38,848 identifying as Hispanic or Latinos.[24] The third largest city is Springfield, with a population of 155,032, with 67,904 identifying as Hispanic or Latino.[25] Inclusion criteria for study participants was limited to adults, 18 years of age

or older, residing in Massachusetts and self-identifying as Hispanic or Latino. Participation was voluntary and there were no monetary incentives or promises of goods or services for completing the survey.

A power analysis (G*Power)[26-27] for the most conservative planned statistical test (one-way ANOVA, two-tailed, four groups) using a medium effect size (f=0.25), α=.05, and 80% power suggested a minimum sample size of n=180.[26,27] Adjusting for expected attrition of 30% the final recommended sample size was n=257.

Instruments

The survey was a combination of three validated surveys, the New Oral Health Literacy Instrument for Public Health,[28] the American Dental Association's Health Policy Institute survey,[29] and the Short Acculturation Scale for Hispanics.[14] The New Oral Health Literacy Instrument for Public Health by Naghibi et al.,[28] consisted of fifteen questions that evaluated oral health knowledge and was used to correlate with data obtained about utilization. For purposes of this study certain questions were edited to improve clarity for the participant and consistency throughout the survey. Namely, items regarding time of day were changed to conventional time notation, as opposed to military time. Additionally, a dental term, calculus, was replaced with the lay term tartar in one instance. The original New Oral Health Literacy Instrument for Public Health has been validated by six oral public health specialists, a methodologist, and a health education expert, scoring relevancy, clarity, simplicity, and necessity of the items to calculate the content validity index (0.90) and content validity ratio (0.85).[28]

Seventeen questions from the American Dental Association's Health Policy Institute survey were selected to capture demographic information, socioeconomic data and self-reported utilization data.[29] Oral health utilization was determined by recent dental visits, established dental home and intent to have a dental visit within the next twelve months. Input and validation for the American Dental Association's Health Policy survey was provided by six international experts that have published on matters defining and measuring oral health based on self-reported indicators.[29]

The Short Acculturation Scale for Hispanics survey (SASH), consisting of four questions, assessed acculturation and was used to correlate with data obtained from the American Dental Association survey.[14] SASH is a language based, five-point bipolar scale and was validated by researchers in a large sample of patients with breast cancer.[30] The score categories were validated by examining the distribution of other variables related to acculturation, including education and literacy level, country of origin, number of years in the U.S., and parental birthplace.[14] In recent years the SASH scale was tested in an independent study and was found to have a high degree of correlation with variables commonly used as proxies for acculturation, which strengthens its validation.[14]

All survey questions were translated into Spanish and back translated into English by independent translators to ensure accuracy. The survey, in English and Spanish, was uploaded to an online survey platform (Qualtrics; Provo, UT, USA) for distribution. The final survey included 35 items, with three of the knowledge questions having more than one answer per question.

Procedures

Participants were recruited in Massachusetts from Spanish-speaking churches of various denominations, community centers that served the Hispanic and Latino community, Hispanic and Latino social and professional groups and through social media. Interested individuals were able to access the survey via a link to the electronic platform. The link was sent either via email, text, messenger, or was made accessible on social media. The opening page was set to default to either "English" or "Español (America Latina)" depending on the audience or group being addressed but was able to be changed by the participant via a drop-down menu on the upper hand corner of the survey. If the participant met the inclusion criteria and consented to the survey by clicking on 'Yes', they gained access to the complete survey in their desired language.

Data analysis

Continuous variables were analyzed using the median for central tendency and the inner quartile range (IQR) as a measure of variance. Categorical demographic variables and survey response categories were summed (count) and then divided by *n* to determine category percentage. Relationships between acculturation and oral health care utilization were analyzed using independent sample t-tests with α=0.05. The relationship between acculturation and oral health knowledge was examined using Pearson's correlation and α=0.05. The data gained from this survey were analyzed using a statistical software program (SPSS version23; IBM Corp., Armonk, NY, USA).

Results

Of 315 individuals accessing the survey link, a total of 230 participants completed the survey for a completion rate of 73% (n=230). Seventy percent (n=160) of the participants were females with an average age of 42 years. Over half (54%, n=123) stated they were married or in a civil union and had at least one person 18 years old or younger living in the home

(55%, n=127). One half (51%, n=119) had completed at least an Associate degree and 60% (n=136) employed full time.

Responses to the 15 items regarding oral health knowledge (New Oral Health Literacy survey) are shown in Table I. Each question was coded as either correct (1 point) or incorrect (0 points). All accumulated points were calculated to create a total number of correct oral health questions. The average knowledge score was 11.3 (SD=2.8) out of 15 possible points (75.3% score). One third of participants (32%, n=75) correctly answered 10 or fewer items (equating to a score lower than 70%).

To assess the relationship between demographic variables and knowledge, a t-test of independent groups was used with demographic categories as independent and total number of correct responses as a dependent variable. Participants with dental insurance had a higher mean number of correct responses (M=12.9, SD=3.2) as compared to those without (M=10.6, SD=3.7), p=0.003. Females had a higher mean knowledge score (M=13.2, SD=3.7) than males (M=11.6, SD=3.1), p=0.001. Participants who were married or in a civil union had a higher mean knowledge score (M=13.2, SD=2.9) as compared to all other relationship status (M=12.0, SD=2.9), p=0.02. All other comparisons of demographic variables and utilizations variables were nonsignificant (p>.05) or had an insufficient number of participants to conduct the test.

Oral health care utilization was assessed using descriptive statistics for three utilization and two insurance questions. The majority had a dental home (78%, n=180) and had visited the dentist in the last 12 months (77%, n=176). A majority of participants (90%, n=207) said they planned to visit the dentist in the next 12 months. Unsurprisingly, oral health utilization was related to whether a participant has dental insurance. Participants with dental insurance (79%, n=181) were more likely to have visited the dentist in the last 12 months (88%, n=159) than those without (35%, n=17), $\chi 2$=60.6, p<0.001, phi=0.51. Participants with dental insurance were also more likely to have a dental home (91%, n=165) compared to those without (31%, n=15)), $\chi 2$=83.1, p<0.001, phi=0.60. Participants with dental insurance were also more likely to indicate they would visit the dentist in the next 12 months (97%, n=175)) than those without dental insurance (65%, n=32), $\chi 2$=42.2, p<0.001, phi=0.43. The frequency of oral health utilization is shown in Table II.

The relationship between acculturation and utilization was assessed using independent sample t-tests. Utilization categories were used as independent groups and the mean SASH score was the dependent variable. The mean SASH score for the sample was 2.8 with a standard deviation of 1.2. When reviewing the SASH scores, the higher numerical values are interpreted as more acculturated, and lower numerical values are interpreted as less acculturated. Participants without a dental home had a lower SASH score (M=2.5. SD=1.3) than those with a dental home (M=2.9, SD=1.2), t(230)=2.2, p=0.03. By extension, participants who had not been to see the dentist in the last 12 months also had a lower SASH score (M=2.5, SD=1.2) than those who had (M=2.9, SD=1.2), t(230)=1.9, p=0.05. Participants who do not intend to visit the dentist in the next 12 months had a lower mean SASH score (M=2.2, SD=1.3) than those who intend to visit the dentist (M=2.9, SD=1.2), t(230)=2.5, p=0.01. Lastly, participants without dental insurance had a lower mean SASH score (M=2.4, SD=1.3) than those with dental insurance (M=2.9, SD=1.1), t(230)=2.6, p=0.01. The SASH scores for the sample are shown in Table III.

Chi-square test of independence was used to compare the demographic variables to utilization variables. Females were more likely to have a dental home (83%, n=133) than males (67%, n=47; $\chi 2$=7.3, p=0.007, phi=0.18). Females were also more likely to have visited the dentist in the last 12 months (81%, n=131) compared to males (46, 66%), $\chi 2$=6.5, p=0.01, phi=0.17. Females were also more likely to have dental insurance (93%, n=149) than males (81%, n=70; $\chi 2$=7.1, p=0.008, phi=0.17), but were not more likely to say they intended to see the dentist in the next 12 months (92%, n=147) compared to males (86%, n=60), $\chi 2$=2.1, p=0.15, phi=0.09. It is important to note that while chi-square tests did indicate relationships between gender and utilization the phi coefficients suggested the strength of these relationships were small. All other comparisons of demographic variables and utilizations variables were not significant (p>.05).

The relationship between acculturation and utilization was assessed with four independent group t-test using utilization categories as independent groups and SASH score as the dependent variable. The mean SASH score was lower for participants without a dental home (M=2.5, SD=1.3), without insurance (M=2.4, SD=1.3), without a dental visit in the last 12 months (M=2.5, SD=1.2), and for participants who were unsure or had no intent to visit the dentist in the next 12 months (M=2.2, SD=1.3) compared to their counterparts. All measures of central tendency and p-values are displayed in Table IV.

Discussion

In general, most of the participants in this study reported utilizing oral health services, however about 23% had not accessed any care. Of that group, 16% had not visited a dentist in the last 12 to 24 months, 4%, in the past three to five years

Table I. Oral health knowledge responses* (n=230).

Question	Response	n	%
Research shows that there may be a link between oral diseases and other health problems such as _____.	Don't know	124	53.9
	Mental illness	13	5.7
	Muscular Dystrophy	2	0.9
	Myocardial infarction	69	30.0
	Skin disease	22	9.6
One of the most common oral diseases is tooth decay. Brushing with toothpaste that contains _____(a) at least twice a _____(b) with flossing and avoid foods with lots of _____ (c)_____ could prevent tooth decay.	(a)Detergents	2	0.9
	Don't know	25	10.9
	Flavors	11	4.8
	Fluoride	173	75.2
	Whitening	19	8.3
	(b) Day	196	85.2
	Don't know	17	7.4
	Meal	11	4.8
	Month	1	0.4
	Week	5	2.2
	(c)Don't know	19	8.3
	Fat	2	0.9
	Salt	8	3.5
	Spices	7	3.0
	Sugar	194	84.3
Every person has 32 _____ teeth	Deciduous	2	0.9
	Don't Know	43	18.7
	Incisors	8	3.5
	Molar	7	3.0
	Permanent	169	73.5
	Missing	1	0.4
which they get the _____ at six years old.	All of them	10	4.3
	Don't know	29	12.6
	First one	91	39.6
	Last one	19	8.3
	Most of them	80	34.8
	Missing	1	0.4

Question	Response	n	%
In this part you will see a prescription for antibiotic consumption. Please the best answer for each question. Rx Diagnosis: Infection and dental abscess Treatment: Amoxicillin (500 mg) capsules (21) Take one capsule by mouth three times (every 8 hours) a day for 7 days If you take the first capsule at 2 pm, when should you take the next one?	10:00 am	9	3.9
	10:00 pm	196	85.2
	11:00 pm	1	0.4
	12:00 am	2	0.9
	2:00 am	3	1.3
	2:00 pm	1	0.4
	3:00 am	1	0.4
	6:00 am	2	0.9
	6:00 pm	2	0.9
	7:00 am	1	0.4
	7:00 pm	1	0.4
	8:00 pm	1	0.4
	9:00 pm	4	1.7
	Don't know	4	1.7
	Missing	2	0.9
If your symptoms are gone by the 4th day of taking the medication, should you stop taking the medication?	Don't know	10	4.3
	No	188	81.7
	Yes	32	13.9
In this part you will see instructions from a bottle of mouth rinse. Choose the best answer for each question. Sodium fluoride mouth rinse 0.2 % Swish and spit 5cc for 1minute one time per week, then do not eat and drink anything for 30 minutes. With regard to this prescription can you swallow it?	Don't know	9	3.9
	No	209	90.9
	Yes	12	5.2

Question	Response	n	%
If you use it at 12 am, when can you eat or drink?	1:00 am	8	3.5
	12:00 am	2	0.9
	12:30 am	192	83.5
	2:00 am	2	0.9
	2:30 am	2	0.9
	3:00 am	1	0.4
	3:30 am	1	0.4
	4:00 am	1	0.4
	6:00 am	4	1.7
	7:00 am	2	0.9
	7:30 am	1	0.4
	8:00 am	1	0.4
	Don't know	3	1.3
	Missing	10	4.3
In this part you will read some sentences with instruction on care after getting a tooth pulled (extraction). Please select the best answer to each item. Bite down on a moist gauze pad for 30 minutes on the site of the extracted tooth Do not spit out for 12 hours Eat cold and soft foods, like ice cream or cold soup for 12 hours after the tooth extraction If your tooth was extracted at 8 am, when should you take gauze out of your mouth?	10:00 am	4	1.7
	10:30 am	1	0.4
	11:00 am	3	1.3
	12:00 pm	6	2.6
	8:00 am	4	1.7
	8:30 am	183	79.6
	9:00 am	11	4.8
	9:30 am	1	0.4
	Don't know	14	6.1
	Missing	3	1.3
If your tooth was extracted at 8 am, can you eat hot food at 2 P.M?	Don't know	7	3.0
	No	198	86.1
	Yes	25	10.9
What is the best decision if a little bleeding occurs after brushing or flossing?	Chewing gum instead of brushing or flossing	3	1.3
	Continue brushing and flossing daily	185	80.4
	Do not brush and floss daily	9	3.9
	Don't know	23	10.0
	Use toothpick instead of brushing and flossing	10	4.3

Question	Response	n	%
Which is the best decision if pain and swallowing occur in your month?	Consultation with family	1	0.4
	Don't know	6	2.6
	Go to the doctor or dentist	194	84.3
	Take an analgesic	10	4.3
	Take an antibiotic	19	8.3
Which of the following is the best way to remove stain and tartar from a person's teeth?	Don't know	21	9.1
	Eating hard foods like apples	2	0.9
	Getting a dental cleaning	169	73.5
	Rinsing with a mouthwash	10	4.3
	Use anti tartar and extra whitening toothpaste	28	12.2
What is the meaning of "I exonerate my dentist from unintentional complications of treatment" in your opinion?	I consent to my dentist proposed treatment	11	4.8
	I don't understand what that sentence means	34	14.8
	I give my permission to my dentist to do any treatment necessary	21	9.1
	My dentist is not responsible for unintentional complications of treatment	159	69.1
	My dentist is responsible for unintentional complications of treatment	5	2.2
What is the meaning of "I have a history of allergy to some drugs" in your opinion?	I don't understand what the sentence means	37	16.1
	I feel anxiety and dizziness after taking some drugs	8	3.5
	I feel inability to breath and redness in my skin after taking some drugs	161	70.0
	I feel problem in speaking and convulsing after taking some drugs	14	6.1
	I get severe chest pain after taking some drugs	6	2.6
	Missing	4	1.7

*New Oral Health Literacy survey

Table II. Frequency of oral health care utilization (n=230).

		n	%	95% Lower CL	95% Upper CL
Do you have a single dentist or dental office that is your usual source of dental care?	no	50	21.7	16.8	27.4
	yes	180	78.3	72.6	83.2
How long since you last had a dental visit?	<12 months	176	76.5	70.7	81.6
	1 to 2 years	37	16.1	11.8	21.2
	3 to 5 years	10	4.3	2.3	7.6
	> 5 years	7	3.0	1.4	5.9
Do you plan to visit the dentist in the next 12 months?	No or not sure	23	10.0	6.6	14.4
	Yes	207	90.0	85.6	93.4
Do you currently have health insurance for 2019?	No	24	10.4	7.0	14.9
	Yes	206	89.6	85.1	93.0
Do you currently have dental insurance for 2019?	No	49	21.3	16.4	26.9
	Yes	181	78.7	73.1	83.6

Table III. Short Acculturation Scale for Hispanics (SASH) mean response by item* (n=230)

	Mean	Standard Deviation
In general, what language(s) do you read and speak?	2.8	1.1
What language do you usually speak at home?	2.7	1.4
In what language do you usually think?	2.8	1.4
What language do you usually speak with your friends?	3.0	1.3
Acculturation**	2.8	1.2

*1=Only English, 2=English better than Spanish, 3=Both equally, 4=Spanish better than English, and 5=Only Spanish

**Average of all 4 items from the SASH

and 3%, in over five years. While utilization of oral health services can be affected by many variables this study sought to highlight the factors that impacted the use of oral health services for the Hispanic and Latino population of Massachusetts.

Dental insurance was associated with oral health knowledge and utilization of dental services. Overall, two-thirds of the participants (67%) had an average knowledge score, answering 73% or more of the questions correctly and higher oral health knowledge scores were achieved by participants that had dental insurance. Similar findings were reported by Edwards et al., where respondents with adequate health literacy were three times more likely to have had dental insurance than those with lower levels of health literacy.[31] Participants with dental insurance were more likely to utilize oral health services, including establishing a dental home and planning for a dental visit within the next 12 months. By having dental insurance, individuals may be more likely to actually utilize dental services and are also benefiting from the dental education and guidance provided to them during their care. This also supports existing data reported by Zivkovic et al., of associations between dental insurance, improved dental visiting behaviors and oral health status outcomes, especially among lower income populations.[32] Participants in this study who had not utilized oral health services in the last 12 months indicated that affordability was a factor. Respondents further specified that the necessary treatment was not covered by their insurance or Medicaid plan and the out-of-pocket expense was prohibitive. These findings highlight the importance of affordable comprehensive dental insurance as it relates to utilization. Policy makers should strive to improve access to affordable dental services and consider expanding dental coverage to the same extent that medical care is currently covered. Although Massachusetts has mandated health coverage, it does not require adult dental coverage.[20] There are some health insurances that provide basic coverage for certain preventive dental services, eligibility is often limited to children.[21,33] Additionally, many Hispanic and Latino immigrants may not be eligible to apply for any dental insurance because of their immigration status. Findings suggest that expanding comprehensive dental coverage in Massachusetts would increase use of oral health services among the Hispanic and Latino population and narrow the gap in oral health disparities.

This study also found an association between utilization and acculturation,

Table IV. Independent t-test results comparing acculturation scores and utilization (n=230).

		Acculturation			
		n	Mean	Standard Deviation	*p*
Do you have a single dentist or dental office that is your usual source of dental care?	No	50	2.5	1.3	0.03
	Yes	180	2.9	1.2	
How long since you last had a dental visit?	> 12 months	54	2.5	1.2	0.05
	< 12 months	176	2.9	1.2	
Do you plan to visit the dentist in the next 12 months?	No or not sure	23	2.2	1.3	0.01
	Yes	207	2.9	1.2	
Do you currently have dental insurance for 2019?	No	49	2.4	1.3	0.01
	Yes	181	2.9	1.1	

as measured by the SASH score. Participants with lower SASH scores, were considered less acculturated and vice versa. This study found participants that were more acculturated were more likely to have a dental home. When an individual has a dental home, they can establish an ongoing relationship with the dental team and benefit from comprehensive, coordinated, oral health care that is continuously accessible.[34] Establishment of a dental home also provides patients with anticipatory guidance to prevent and manage oral disease.[34] Having a dental home is an important way to encourage routine care and allows the dental team to establish a rapport with the patient. However, less acculturated individuals may find it difficult to establish a rapport when there is a language barrier and cultural divide which can in turn contribute to health disparities.[35] Participants who were less acculturated were not utilizing oral health services to the same degree as those that were more acculturated, possibly due to a lack of English proficiency, less comfortable navigating the new culture or the dental health system. These findings are consistent with the literature about sociocultural barriers to care.[15,35] Nearly one fourth of the respondents who did not utilize oral health services indicated that they did not know where to go for services or that they could not find a dentist to accept their insurance plan. This finding underscores an opportunity for improving dental outreach, promoting oral health services, and providing resources for people so they know where to go for help.

Research by Patino et al., showed that lower oral health knowledge was associated with low acculturation, specifically in those with low English proficiency and for those who preferred a Spanish-speaking oral health care provider.[35,36] This points to the importance of equitable health care, and the need for oral health care providers to be culturally competent and provide education and treatment options in the language the patient is most comfortable with.[35] Strategies to improve utilization of oral health services among the Hispanic and Latino population should include access to interpreter services at point of care, access to linguistically diverse printed materials such as post-op instructions and educational brochures and extensive training for the dental team on cultural awareness, diversity and inclusion. Such strategies should also include the expansion of dental insurance coverage or the addition of preventive oral health services within medical coverage. Further research could expand on acculturation and oral health; cultural diversity among the dental profession and impact on patient satisfaction and oral health outcomes; or patient perceptions of care in culturally diverse communities. In addition, a study to specifically explore the characteristics and needs of the uninsured Hispanic/Latino population would expand the body of knowledge.

There are limitations to this study. Although most participants completed the survey independently without an interviewer, as with any self-reported survey, there is the possibility of social desirability bias. The study was also conducted in a limited geographic area with a convenience sample, limiting generalizability. Additionally, the survey was electronic. While every effort was made to provide access to the survey to those who expressed interest, there may have been individuals that failed to take the survey because of technical difficulties or struggles with technology. Future studies might consider using various methods of disseminating the survey that does not hinder the participant's ability to respond. While the survey was accessible in English and Spanish, other languages that Latino participants might speak, such as Portuguese, were not available. Future studies might consider translating the survey to Portuguese or other native Latin American languages, to expand the pool of respondents.

Conclusion

Participants of this cross-sectional study provided valuable insight on the factors that are associated with utilization of oral health services among the Latino and Hispanic population. Although oral health knowledge was not directly associated with use

of oral health services, it was associated with dental insurance which was a predictor of utilization of oral health services. Acculturation was also found to be a predictor of utilization, those with less acculturation and less English proficiency had lower utilization of dental services. Improving access to affordable dental coverage, promoting the establishment of a dental home, encouraging cultural sensitivity among the dental team, and providing resources to those with limited English proficiency could improve utilization of oral health services among Latino and Hispanic populations where the patient will feel heard, understood and respected.

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Research

Analysis of 100 Most-Viewed YouTube Toothbrushing Videos

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Abstract

Purpose: Parental education regarding the importance of toothbrushing and how to brush children's teeth is a key factor influencing pediatric oral health and You Tube videos have become a popular source of health information. The purpose of this study was to examine the descriptive features of the 100 most frequently viewed English-language YouTube toothbrushing videos and evaluate their usefulness relative to professional guidelines.

Methods: A structured YouTube web search identified the 100 most frequently viewed toothbrushing videos during a six-month period (10/1/17 – 4/30/18). Two independent evaluators assessed each video for consistency with professional recommendations using *a priori* criteria. Each video was also assessed for descriptive characteristics, user engagement, and content. Comparative analyses by video source (health care professionals, commercial, and independent media) were performed, and an exploratory regression model was used to test the relationship between video characteristics and usefulness for parent education.

Results: The top 100 YouTube videos were most often posted by independent media outlets (78%), targeted toward children (70%), and less than 2 minutes long (56%). Few videos aligned with professional recommendations regarding toothbrushing frequency (38%), toothbrushing duration (24%), amount of toothpaste (21%), fluoride toothpaste use (19%), post-brushing behavior (10%), toothbrush selection (4%), and toothbrush replacement (3%). A stepwise bidirectional regression model found that videos posted by health care professionals were significantly more likely to contain recommendations consistent with professional recommendations compared with other upload sources.

Conclusions: The most frequently viewed toothbrushing videos were not uploaded to the Internet by health care professionals. Videos uploaded by health care professionals contained significantly higher counts of professional recommendations however, they differed in audio and visual format and production style compared to those from commercial and independent media sources.

Keywords: toothbrushing, YouTube, patient education, pediatric oral health, instructional video

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Introduction

Proper toothbrushing is essential to maintaining oral hygiene and preventing dental caries,[1-2] a disease that remains a significant pediatric public health problem in the United States (US).[3-5] The American Dental Association (ADA) recommends toothbrushing as part of a daily regimen to maintain oral health, advising the public to brush twice daily for 2 minutes with a soft-bristled toothbrush and fluoride toothpaste. The ADA also recommends using a toothbrush that fits the mouth and allows all areas to be reached, angling the toothbrush at 45 degrees to the gum line, using short gentle strokes, and replacing a toothbrush every 3 to 4 months.[4] The American Academy of Pediatric Dentistry (AAPD) recommends using a smear or rice-sized amount of fluoridated toothpaste for children younger than 3 years and a pea-sized amount for children aged 3-6 years.[5] For preschool-aged children, parents are advised to dispense toothpaste onto a soft toothbrush of age-appropriate size and to perform or assist with their child's toothbrushing. To optimize the fluoride benefits of toothpaste, the AAPD recommends that rinsing after brushing be minimal, or not done at all.[5]

Despite clear professional guidelines, many parents do not follow brushing recommendations with their children.[6] Horowitz et al.[7] reported that parents of young children did not know how to advise their children to brush and had limited understanding of the importance of fluoride in preventing caries. Parents have cited the complexity and diversity of advice provided by a wide range of dental associations, professionals, companies, and oral health literature as barriers to adherence.[8] They also reported that socioeconomic-related barriers, including difficulty managing their stressful lives, prevent them from adhering to toothbrushing guidelines beyond simple reminders to their children to brush rather than direct supervision of their brushing.[9] The lack of parental adherence to children's toothbrushing recommendations may also be associated with low oral health literacy, which encompasses knowledge of the processes responsible for dental disease as well as the ability to apply that knowledge, use the health care system for dental checkups and care, and implement oral hygiene practices.[7,10] Low oral health literacy has been associated with increased rates and severity of caries, irregular and missed dental appointments, and less dental knowledge and access to dental care.[7,11-14] In addition, low oral health literacy has also been associated with underserved and vulnerable groups, including those who live in rural areas, have low income or educational levels, or are racial or ethnic minorities.[7,15-17]

While oral health information is available from a variety of print sources, the internet has become a primary source of health information,[18] to the extent that the US Food and Drug Administration has a posted advisory on how to assess the validity of web-based health advice.[19] Most families, including those with low household incomes, have access to the internet and believe it is a useful resource for finding health information.[20] The Pew Research Center[21] reported that 59% of people in the US have used the internet as a source of health information, and 26% of those have watched or read about another's experience with health or medical issues. However, many internet sites are text based and present information at advanced reading levels that may limit accessibility for individuals with lower literacy levels.[22] Online videos offer an alternative to text-based materials, and have been associated with increased comprehension when compared with written sources among children and adults with low literacy levels.[23]

Evidence suggests that people are increasingly turning to YouTube for dental guidelines. According to Google Trends, the search for toothbrushing videos on YouTube in the US increased between 2008 and 2018.[24] Several studies have analyzed the content of YouTube videos related to early childhood caries, fluoride, dental anxiety, and oral hygiene.[25-27] For example, Duman[28] analyzed top-listed YouTube videos about children's oral hygiene and found that most videos were useful in conveying oral health information about toothbrushing, flossing, and visiting the dentist. The purpose of this study was to examine the most frequently viewed toothbrushing videos on YouTube and assess their characteristics, viewer engagement, educational content, and adherence to professional guidelines and recommendations.

Methods

This study was deemed exempt by the Columbia University Irving Medical Center Institutional Review Board. An internet search was conducted by two investigators (G.Z. and H.G.) between October 1, 2017, and April 30, 2018, to identify the 100 most frequently viewed You Tube videos, using the search terms *toothbrushing*, *how to brush teeth*, and *brushing teeth*. A list of 100 videos was generated for each of the 3 search terms. Inclusion criteria were videos in the English language that included information about instructional toothbrushing (i.e., the method or frequency of brushing). Videos that did not fit these inclusion criteria, that were duplicates, or that showed content irrelevant to instructional toothbrushing were excluded. A master list of the 100 most-viewed videos was combined from the three initial lists, which comprised videos identified through the search term *toothbrushing* (n=33), the term *how to brush teeth* (n=28), and the term *brushing teeth* (n=39).

All toothbrush types, hand and electric, were included in the videos selected. In total, 3% of videos mentioned electric toothbrushes only, 78% mentioned manual toothbrushes only, 5% mentioned electric and manual toothbrushes, and 4% mentioned other toothbrush types, such as 360 degree brushes. Only common techniques for toothbrushing were captured; these techniques included the Bass method (i.e., brushing at a 45-degree angle to the gum line), the Fones circular method, and the back-and-forth or scrubbing method. Videos were classified by the upload source indicated as: health care professionals (e.g., dentists, dental assistants, and governmental and private health organizations), independent media outlets (e.g., YouTube content creators, bloggers, individual users, and small media outlets), and commercial outlets (e.g., commercial television, radio, and advertisements for hospitals, services, and products).

The investigators rated the videos independently according to three domains; characteristics, engagement, and content. Interrater reliability was calculated as percent agreement. The characteristics domain assessed video length, audio and visual formats, target audience, and upload source. The engagement

domain was evaluated through the number of views, likes, dislikes, comments received, and other newly created variables (specifically viewing and interaction rates). The content domain was examined for consistency with recommendations from the AAPD and ADA. A full explanation of the variables included in these domains is provided in Table I.

A usefulness score variable was created to evaluate the thoroughness of the videos with regard to mentioning essential professional guidelines related to brushing duration, frequency, and use of brushing products. The age-specific variables related to toothpaste amount and brushing methods were excluded from the usefulness score because of the wide range of ages among the target audiences. The score was calculated by adding a value of 1 for each of the guidelines—soft-bristled toothbrush, fluoride toothpaste, brushing for 2 minutes, and brushing twice a day—featured in the video, resulting in a continuous measure ranging from 0-4.

Preliminary descriptive statistics, including frequencies, percentages, means, ranges, and 95% confidence intervals (CIs), were calculated using a statistical software program (SPSS version 25, IBM; Armonk, NY.). The normality of the continuous variables was investigated through the use of Kolmogorov-Smirnov tests. Because the continuous variables were not normally distributed, Kruskal-Wallis tests and *post hoc* Mann-Whitney U tests were used to examine differences in the relationships between upload source and viewer engagement (measured as viewing and interaction rates). Differences in video content and characteristics (categorical variables) by video upload source were examined using Fisher exact tests. A bidirectional stepwise regression procedure was used to identify a model that would predict video content usefulness as indicated by adherence to main professional guidelines. Only those predictors with corresponding *p*-values less than 0.05 in the simple regression analysis were considered, with a significance threshold of $p \leq 0.05$ used in the model selection process.

Results

Video characteristics

Interrater percent agreement differed by domain, varying from 80% for content, 85% for characteristics, and 100% for engagement. Video length varied from 25 seconds to 13 minutes and 47 seconds, with a median length of 4 minutes and 24 seconds (interquartile range [IQR]=1:54-4:54). The majority of the most frequently viewed YouTube toothbrushing videos were uploaded by independent online media sources such as YouTube content creators, bloggers and individual users, (77.0%, n=77) and developed for pediatric audiences (85.0%, n=85). More than one-half of all videos featured musical elements (55.6%, n=55), and more videos featured live action (39.0%, n=39) than animation (23.0%, n=23), cartoons (27.0%, n=27), or combined elements (11.0%, n=11).

An analysis of variance (Kruskal-Wallis H test) indicated a statistically significant difference in how long the video was posted in YouTube (video age in days) between the upload sources (chi-squared [χ^2]=12.0, p=0.001). Mann-Whitney U tests were performed *post hoc* to identify the differences between groups and revealed significant differences in the mean rankings (MRs) for video age between videos uploaded by independent media outlets (MR=40.0) and health care professionals (MR=58.6, $p<0.05$). No statistically significant differences in video length between upload sources were found.

Videos created and uploaded by health care professionals (n=16) featured more live action, less music, and less children's content than videos uploaded by independent media outlets or commercial outlets and advertisers. In contrast, most of the videos uploaded by independent media outlets were designed for pediatric audiences (97.4%, n=75) and contained musical elements (68.8%, n=53).

Viewer engagement

Of the 100 most-viewed YouTube videos on toothbrushing, 70.0% were viewed at least 1 million times. In total, the 100 videos in the sample were watched 1,284,560,839 times, and the number of views per video ranged from 280,244 to 50 million. The median score was 1,600 (IQR=832-6,200) for number of likes, 538 (IQR=182-1,900) for number of dislikes, and 114 for number of comments (IQR=37-294).

The Kruskal-Wallis H test showed that there was a statistically significant difference in viewing rate between upload sources (χ^2=13.4, p=0.001). *Post hoc* Mann-Whitney U tests were performed to identify the differences between groups, which revealed significant differences in the MRs for viewing rates between videos uploaded by health care professionals (MR=9.6) vs. commercial outlets (MR=16.7, $p<0.05$) and health care professionals (MR=21.7) vs. independent media outlets (MR=49.0, $p<0.001$). No statistically significant differences were found between the 3 upload sources in terms of video interaction rate.

Video content

Overall, a minority of the 100 most-viewed videos presented adequate information consistent with ADA and AAPD toothbrushing guidelines (Table II). The most common AAPD and ADA recommendations presented in the videos were brushing twice a day (39.0%, n=39), brushing for

Table I. Domains, variables, and response categories

Domain	Variable	Response categories
Video characteristics: Descriptive features of the YouTube video	Video length	Minutes, seconds
	Target audience	Children (includes pretend play, games, cartoons, musical elements, singing, and mascots) Adults (uses technical language and includes references to adult topics of interest)
	Audio format	Musical Non-musical (musical elements comprised <50% of the video)
	Visual format	Live action Animation, including dynamic content with moving images Cartoon, including 2-dimensional content Combined, including 2 or more of the described formats
	Upload source	Health care professionals (e.g., dentists, dental assistants, and governmental and private health organizations) Independent media outlets (e.g., YouTube content creators, bloggers, individual users, and small media outlets) Commercial outlets (e.g., commercial television, radio, and advertisements for hospitals, services, and products)
Viewer engagement: Measures of viewer engagement with the video at the time of measurement	Number of views	Numeric
	Number of likes	Numeric
	Number of dislikes	Numeric
	Number of comments received	Numeric
	Viewing rate	(n) views | (n) days since upload
	Interaction rate	(n) likes - (n) dislikes x 100/n (views)
Content: Assessment of whether the video addressed the specific professional guideline	Soft toothbrush	0 - Did not include | 1 - Included
	Age-appropriate toothbrush	0 - Did not include | 1 - Included
	Fluoride toothpaste	0 - Did not include | 1 - Included
	Age-appropriate amount of toothpaste	0 - Did not include 1 - Included
	Brushing at a 45° angle	0 - Did not include | 1 - Included
	Brushing in a circular motion	0 - Did not include | 1 - Included
	Brushing in a scrubbing motion	0 - Did not include | 1 - Included
	Brushing duration (2 min)	0 - Did not include | 1 - Included
	Brushing frequency (twice per day)	0 - Did not include | 1 - Included
	Replace toothbrush every 3-4 months	0 - Did not include | 1 - Included
	Spitting out toothpaste after brushing is complete	0 - Did not include | 1 - Included

Table II. Educational content related to toothbrushing by video upload source (n=100)

Educational content*	All videos (n=100) n (%)	Video upload source			*p*-value**
		Healthcare professional (n=16) n (%)	Independent media outlet (n=78) n (%)	Commercial media outlet or advertiser (n=6) n (%)	
Brushing product					
Soft toothbrush	13 (13.0)	9 (56.3)	2 (2.6)	2 (33.3)	<0.001†
Age- appropriate toothbrush	4 (4.0)	3 (18.8)	0	1 (16.7)	<0.001†
Fluoride toothpaste	19 (19.0)	6 (37.5)	12 (15.4)	1 (16.7)	0.13
Age-appropriate toothpaste amount	21 (21.0)	3 (18.8)	15 (19.2)	3 (50.0)	0.18
Brushing method					
At 45^0 angle	17 (17.0)	11 (68.8)	5 (6.4)	1 (16.7)	<0.001†
Circular motion	35 (35.0)	3 (18.8)	30 (38.5)	2 (33.3)	0.32
Scrubbing motion	57 (57.0)	3 (18.8)	51 (65.4)	3 (50.0)	0.002‡
Brushing duration					
2 min	24 (24.0)	8 (50.0)	12 (15.4)	4 (66.7)	<0.001†
Brushing frequency					
Twice per day	38 (38.0)	9 (56.3)	25 (32.9)	4 (66.7)	0.07
Post-brushing care					
Spit out toothpaste	10 (10.0)	2 (12.5)	5 (6.5)	3 (50.0)	0.01§
Replace brush every 3-4 months	3 (3.0)	2 (12.5)	0	1 (16.7)	0.004‡

*Based on current recommendations from the American Dental Association and the American Academy of Pediatric Dentistry.**Fisher exact test was used because cell count was <5 for all observations.

† $p<0.001$. ‡ $p<0.01$. § $p\leq0.05$.

2 minutes (24.0%, n=24), using an age-appropriate amount of toothpaste (21.0%, n=21), using fluoride toothpaste (19.0%, n=19), using a soft-bristled brush (13.0%, n=13), using an age-appropriate toothbrush (4.0%, n=4), and replacing a toothbrush every 3 to 4 months (3.0%, n=3). In addition, the most common brushing techniques featured in the sampled videos were back-and-forth scrubbing motions (57.0%, n=57) followed by circular motions (35.0%, n=35) and brushing at a 45-degree angle to the gum line (17.0%, n=17).

The subset of videos created and uploaded by health care professionals most closely tracked professional association recommendations for using a soft-bristled toothbrush (56.0%, n=9) and brushing for 2 minutes (50.0%, n=8). In comparison, videos uploaded by independent media outlets were much less likely to mention brushing for 2 minutes (15.0%, n=12) or using a soft-bristled brush (3.0%, n=2).

Video usefulness

A stepwise regression analysis was conducted to evaluate the relationship between video characteristics and the inclusion of key professional recommendations for toothbrushing as indicated by the usefulness score. In step one of the analysis, audio format was included in the regression equation and found to be significantly associated with video usefulness, account-ing for approximately 23.0% of the variance in video usefulness (multiple correla-tion coefficient [R^2]=0.228). Video upload source was included in the regression equation during step two, accounting for 8.5% of the variance, and visual format was included during step three, accounting for

6.0% of variance. Overall, the most significant variables, which comprised 33% of the variance (R^2=0.334) in usefulness, were audio format (non-musical) (B=0.586, $p \leq 0.05$), upload source (health care professional) (B=0.409, $p \leq 0.01$), and visual format (live action) (B=0.544, $p \leq 0.01$).

Discussion

This study aimed to explore the descriptive characteristics of the most popular toothbrushing YouTube videos and identify any associations between these characteristics and viewer engagement and adherence to professional guidelines by upload source. Descriptive data indicated that most of the videos created and uploaded by health care professionals were designed for adult audiences and featured a live action format using technical language. In contrast, videos uploaded by commercial outlets and advertisers were primarily aimed at children and contained cartoons and animation with music.

Videos created and uploaded by independent media outlets, including individual YouTube content creators and small media channels, constituted the bulk of the top 100 videos, indicating their popularity and widespread reach compared with videos uploaded by other sources. This finding was somewhat unexpected, as most of the overall content on YouTube is not uploaded by independent media outlets or individuals but by large commercial media corporations, such as CBS, BBC, Vevo, and Hulu.[29] This finding was also divergent from the results of Duman,[28] who found that most YouTube videos about oral hygiene were uploaded by health care professionals and academic and professional organizations; however, Duman[28] excluded all cartoons, musical videos, and commercial videos from the analysis. While Duman[28] did not find any significant association between upload source and viewing or interaction rates, videos uploaded by independent media in the present study sample generated higher viewing rates than videos uploaded by commercial or independent sources. However, no significant differences were found in video interaction rates among all 3 upload sources. Future research is needed to investigate predictors of video viewership. YouTube channels established by independent media outlets may have a well-established fan base, a larger number of videos, and more engaging content than other types of channels.

Although most of the videos uploaded by independent media outlets were created for children, they provided inconsistent advice on proper toothbrushing methods and appeared be designed for motivational rather than instructional use. These videos emphasized the importance of brushing or having a bright smile rather than following professional recommendations on brushing methods, brushing frequency, or the proper use of fluoride toothpaste. These findings are consistent with a 2018 study by Basch et al.,[26] which reported that the majority of toothpaste advertisements appearing in parents' magazines showed improper use of toothpaste, suggesting that commercial outlets are not positioning themselves to raise awareness about healthy oral hygiene. These types of advertisements may have real-life consequences. For example, a recent survey by the Centers for Disease Control similarly found that nearly 40% of children aged 3-6 years used a brush that was full or half-full of toothpaste, despite the professional recommendation to use no more than a pea-sized amount.[30]

The most common professional recommendations presented in the present study sample were brushing twice a day, followed by brushing for 2 minutes. In contrast, Duman[28] found that brushing time was more frequently mentioned than brushing frequency in oral hygiene videos, a difference that could be attributed to differences in inclusion criteria and review period and method. Duman[28] also found that the majority of videos (77.7%) mentioned the importance of parental supervision during brushing, a content variable that was not investigated in the present analysis.

While the ADA routinely recommends brushing at a 45-degree angle to the gum line (Bass method),[4] the most common brushing techniques featured in the sampled videos were back-and-forth scrubbing motions followed by circular motions (Fones method), with brushing at a 45-degree angle to the gum line the third most common method. This finding was consistent with the proportion of videos aimed at children (85.0%), for whom angled brushing is beyond their manual dexterity. For children, the scrubbing technique may be suitable for pre-schoolers who are learning how to brush but should be replaced in sequence by the circular and angled techniques as their motor skills develop.[31-32]

Overall, this study found that the majority of the 100 most-viewed YouTube toothbrushing videos were not created and uploaded by health care professionals and did not reflect current professional recommendations. Rather, most were created by independent media outlets and designed to appeal to children as motivational rather than instructional sources. However, the videos uploaded by health care professionals were significantly more likely to include accurate, up-to-date professional recommendations. The findings suggest that the credibility of the video's upload source and the quality of the video's content may be less important to viewers than other factors, such as the video's ability to present information in an attractive or entertaining manner. Because YouTube has become a frequently used resource for individuals seeking

health-related information,[21,23-24] this discrepancy raises concern about the quality of oral health care content in popular videos.

Limitations

As with any evaluation of web-based materials, this snapshot study reflects a time- specific assessment of online toothbrushing videos. Because new videos are being uploaded continuously, a longitudinal assessment of the change in web content may be of more value than an assessment at a single point in time. Regarding methodology, the findings were limited by the subjective assessments of 2 independent video viewers. Although their high rates of interrater agreement suggest that *a priori* assessment criteria were reasonably well defined, their assessments remain subjective. In addition, the assessment criteria did not include the evaluation of videos over time. The findings are also limited by the study's small sample size relative to the number of potentially relevant videos, however the small sample was purposeful because the study's goal was to include only popular videos with a large number of views.

The cutoff point for the 100 top-viewed videos was arbitrarily selected; thus, if a different cutoff point had been used, the findings may have been different. This limitation may have led to skewed results given the logarithmic nature of top-viewed video numbers and may have resulted in a reduction in the statistical power to detect differences. In addition, although basic video analytics, such as the average numbers of views, likes, and comments, are commonly used to measure user engagement, they are subject to rapid changes over time.[33] Viewing and interaction rates, which have been previously used in the YouTube research literature,[28,34] seem to provide a way to control for constant count fluctuation in basic video analytics. However, there are no data available about their validity, indicating the need for more robust and well-tested video engagement metrics. Wu et al.[35] has argued that, while video view counts remain the most studied metric for measuring video popularity, the time spent watching videos should also be considered, as it is becoming a primary metric for video recommendations on YouTube. Future studies could extend the analysis to other predictors of video viewing, such as the number of subscribers and videos for specific YouTube channels, and to other visual qualities, such as definition and resolution.

The study's results present both a problem and an opportunity for health care professionals. The findings suggest that health care professionals are not currently creating toothbrushing videos with formats and elements that are likely to receive a large number of views. However, the results also highlight the opportunity that exists for health care professionals to collaborate with popular sources of online instructional videos to improve content and ensure adherence to professional guidelines. Dental professionals can also integrate videos that provide high-quality recommendations about toothbrushing into their existing patient education strategies. Videos can offer a safe learning environment and enhance attention and information recall while being accessible to children of all ages, educational backgrounds, and racial/ethnic groups.[36] It is critical that parents have access to accurate, easily understandable information to improve their oral health literacy and prevent oral diseases in their children.

Conclusions

Findings from this study indicated that the most commonly viewed YouTube toothbrushing videos were uploaded to the Internet by independent media outlets and often did not align with ADA and AAPD toothbrushing recommendations. Videos created and uploaded by health care professionals were less likely to incorporate animation, cartoons, or music in their messaging. However, videos from health care professional sources were significantly more likely to mention accurate professional guidelines.

Disclosure

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Research

Face-touching Behavior during the COVID-19 Pandemic: Self-inoculation and transmission potentials

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Abstract

Purpose: Face-touching behavior has the potential for self-inoculation and transmission of the SARS-2 Coronavirus. The purpose of this study was to observe unconscious face-touching behaviors of dental hygiene and dental students in a non-clinical setting.

Methods: Twenty minutes of archived proctoring videos of dental and dental hygiene students (n=87) while taking final examinations were watched for incidents of face-touching behavior. Data were analyzed for descriptive frequencies; independent sample t-tests were used to determine differences between dental and dental hygiene students and between males and females.

Results: There was a significant difference in face touching behaviors between the student groups. Dental hygiene students (n=42) were observed 11.9 times (SD. 11.4) and dental students (n=45) were observed 8.9 times (SD, 7.9) touching the nose, mouth, and eyes (T-zone) (p=0.049). Differences in frequencies of touching the T-zone failed to reach significance between genders.

Conclusion: Findings suggest both dental hygiene and dental students frequently touch their faces in non-clinical settings and need to be aware of this unconscious behavior. Given the significance of the COVID-19 pandemic, it is important to identify and quantify known risk factors that can be easily addressed to prevent/reduce infection transmission.

Keywords: preventive health behavior, public health, epidemiology, pandemic, mucosal zone, face touching

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Introduction

Face-touching has been identified as an important transmission route to self-inoculate viruses and other transmissible microorganisms.[1] This is a particularly important factor to consider during the COVID-19 pandemic. Guidelines provided by the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) to avoid COVID-19 include limiting close contact with others; wearing a mask; washing hands frequently; and avoiding touching one's eyes, nose, and mouth.[2,3] The eyes, nose, and mouth are areas of the face identified as target mucosal membranes,[4] or the T-zone for infection transmission. Hands may touch many surfaces, some of which may be contaminated with pathogens.

Touching one's eyes, nose, or mouth can potentially transmit (or self-inoculate) pathogens through oro-naso-ocular mucus membranes. For example, bacterial self-inoculation of *Staphylococcus aureus* is possible through face-touching behavior. *S. aureus* has been identified in the nasal mucosa of nearly one-fourth of both community and healthcare settings.[5,6] Similarly, viral self-inoculation is possible through face-touching behavior. Self-inoculation of herpes simplex virus type-1 (HSV-1) may occur if cold sores are touched. Viral transmission to fingers (herpetic whitlow) and eyes (herpes zoster opthalmicus) are possible. The extent to which face-touching behavior is responsible for pathogen transmission in any particular disease is difficult to determine.[5] Nevertheless, there are anecdotal reports demonstrating that decreasing face-touching behavior, particularly of the T-Zone, has resulted in fewer upper respiratory tract infections.[4,7]

When diseases are highly transmissible with high levels of morbidity and mortality, and limited therapeutics, every consideration for safety should be in place. This is especially true for healthcare workers who may inadvertently transmit

disease to themselves or others through unconscious face/mask/respirator touching behaviors. Some face/mask/respirator touching behavior has been attributed to an urge to relieve the irritation of the presence of mild abrasions on the face, especially those resulting from the mask/respirator.[8] Data collected prior to the COVID-19 pandemic has shown that personal protective equipment (PPE) protocol breaches are common. In a study of acute care hospital workers in the United States, 26% of the participants touched the front of their mask while doffing and nearly half of them touched the mask's surface with ungloved hands.[9] In a behavioral observation study in the United Kingdom, medical students were observed for face-touching behavior and participants were shown to have had a mean of four mouth touches and three nose touches per hour.[5]

Face-touching behavior also has cultural differences and gender differences may also be possible. In a study comparing face-touching behavior between British and Japanese participants, the British participants were more likely to touch the left side of the face with the left hand as compared to the Japanese participants.[10] Another study indicated that men were more likely to engage in non-verbal self-touching behavior than women, however women were reported to be more likely to self-touch during anxiety-inducing situations.[11]

Overall, there is limited research examining self-inoculation from face-touching behavior. However, given the nature of the COVID-19 pandemic and the recommendations from the CDC and WHO regarding face-touching and self-inoculation behaviors, it is critical address these behaviors in dental and dental hygiene students so that targeted awareness campaigns and professional education can reduce exposure risks. The purpose of this study was to observe unconscious face-touching behaviors of dental hygiene and dental students in a non-clinical setting and examine whether differences exist between dental and dental hygiene students or between genders.

Methods

This cross-sectional study was approved by the West Virginia University Institutional Review Board (protocol 2003954300). The data used in this study were extracted from archived proctoring videos for dental and dental hygiene courses. These courses had online final examinations following the COVID-19 pandemic shutdown of 2020. The sample consisted of dental students (n=45) and dental hygiene students (n=42); all participants were 18 years or older. Prior to taking the spring semester final examinations, all students (n=87) had access to the School of Dentistry's COVID-19 Task Force's clinical training documents and resources. These resources, based upon guidance from CDC, American Dental Association, Occupational Safety and Health Administration, and the Organization for Safety Asepsis and Prevention, recommended strict infection control policies, which included avoiding touching the T-zone of the face. All dental and dental hygiene students, as well as all faculty members, were required to complete the infection control educational training modules specifically addressing COVID-19 and pass the post-test.

Two researchers (RCW and AKTS) viewed 20 minutes of archived proctoring videos of dental and dental hygiene students taking their online final examinations. In watching the archived proctoring videos, incidents of touching face, eyes, glasses, nose, mouth, hair, and ears were recorded for each student. A statistical program (SPSS version 26, IBM; Armonk, NY) was used for the data analysis. Descriptive statistics are presented as frequencies, percentages, mean, and standard deviation. Differences between the face-touching behavior of dental and dental hygiene students as well as the differences between genders were analyzed using independent samples t-test. Statistical significance was assessed at $p<.05$. Due to limited cell sizes and potential for participant identification, all cell sizes were suppressed when cell was <10.

Results

A total of three videos of dental and dental hygiene students were viewed (n=87). The sample consisted of 24 males (27.9%) and 62 females (72.1%). Approximately half of the students were dental hygiene students (n=42, 48.8%) and the rest were dental students (n=45, 51.2%). The vast majority of the participants (95.5%, n=83) touched the mucosal membrane T-zone (mouth, nose, and eyes) at least once during the twenty minutes of viewing. The mean number of T-zone touches was 10.3 (SD, 9.8; minimum 0, maximum 41). Although not the focus of this study, the mean number of any face touching (mouth, nose, eyes, hair, ear, and/or glasses) was 15.5 (SD, 11.1; minimum 2, maximum 51).

Dental hygiene students were more likely to touch their lips, nose, ears, T-zone, bite their nails, or touch any T-zone, hair, ears, and/or glasses than dental students. Face-touching behavior details of the participants are presented in Table I. In analyzing face-touching behaviors by gender, males were more likely to touch their noses ($p = 0.012$) and females were more likely to touch their lips ($p=0.011$). The difference in touching the T-zone or touching any T-zone, hair, ears, and/or glasses failed to reach significance between the sexes. Face-touching behaviors by gender are shown in Table II.

Table I. Participant T-Zone touching behaviors during 20 minutes of observations (n=87)

T-Zone Touching Frequency	Overall (n=87)	Dental hygiene students (n=42)	Dental students (n=45)	
	n (%)	n (%)	n (%)	*p*-value
Eyes				
0	30 (34.5%)	cell size suppressed[1]	24 (53.3%)	
≥1	57 (65.5%)	35 (83.3%)	21 (46.7%)	
Mean (SD)	1.8 (2.5)	2.3 (2.7)	1.4 (2.2)	.964
Nose				
0	21 (24.1%)	cell size suppressed[1]	12 (26.7%)	
≥1	66 (75.9%)	34 (81.0%)	32 (71.1%)	
Mean (SD)	2.5 (3.2)	2.3 (3.0)	2.8 (3.4)	.208
Lips				
0	27 (27.8%)	11 (26.2%)	16 (35.6%)	
≥1	60 (69.0%)	31 (73.8%)	29 (64.4%)	
Mean (SD)	4.4 (5.4)	5.4 (6.9)	3.4 (3.4)	<.005

[1]Due to limited cell sizes and potential for participant identification, all cell sizes were suppressed when cell was <10.

p-values based on independent samples t-test.

Table II. Participant T-Zone touching behaviors during 20 minutes of observation by gender (n=46)*

T-Zone touching frequency	Male students (n=24)	Female students (n=62)	
	n (%)	n (%)	*p*-value
Eyes			
0	11 (45.8%)	19 (30.6%)	
≥1	13 (54.2%)	43 (69.4%)	
Mean (SD)	1.7 (2.5)	1.8 (2.5)	.498
Nose			
0	cell size suppressed[1]	16 (25.8%)	
≥1	20 (83.3%)	46 (74.2%)	
Mean (SD)	3.7 (3.9)	2.1 (2.8)	.012
Lips			
0	cell size suppressed[1]	21 (33.9%)	
≥1	18 (75.0%)	41 (66.1%)	
Mean (SD)	3.2 (3.3)	4.9 (6.1)	.011

[1]Due to limited cell sizes and potential for participant identification, all cell sizes were suppressed when cell was <10.

*One participant did not report sex.

p-values based on independent samples t-test.

Discussion

Findings from this study showed that over 95% of dental and dental hygiene students unconsciously touched their mucosal membrane T-zone (mouth, nose, and/or eyes) during the first twenty minutes of taking a final examination during the COVID-19 pandemic shutdown in the spring of 2020. Both male and female students demonstrated this behavior although the area of the face touched varied by gender.

In a recent systematic review on the frequency of T-zone touching, amidst the COVID-19 pandemic, no significant difference in face-touching behavior between sexes was identified in nine out of the ten reviewed studies.[1] The review included studies from different settings and regions of the world and it was concluded that the participants touched their eyes, nose, mouth, and chin approximately 69 times per hour.[1] Extrapolating the results from this study from twenty minutes to an hour, there would be an estimated occurrence of 46.5 touches to the T-zone, hair, ears, and/or glasses, indicating rates lower than those of the systematic review.

While there is limited research reporting on the face-touching behaviors of medical/health professionals or students, 5,12 clinicians and staff in medical offices in a study were found to have touched their T-zone an average of 19 times over a two-hour period12 These rates were lower than those observed in the current study. However, face-touching behaviors of health care providers in medical practices might differ based on the setting. In this study, oral health care students were engaged in a stressful activity outside of the clinic setting and unconscious face-touching behavior might have differed due to the environment.

Little has been reported in the literature regarding self-inoculation of respiratory viruses through contaminated hands coming in direct contact with mucous membranes.[1] However, some studies have shown that reducing the frequency of touching eyes, ears, and mouth also reduces the likelihood of respiratory tract infections.[7,12] The question remains as to why future health care providers would continue to exhibit unconscious face-touching behaviors that promote the potential to transfer pathogens to themselves and to others. Researchers believe one of the difficulties for infection control or prevention lies in the fact that pathogens are invisible to the naked eye.[13] The invisible nature of pathogens makes it more difficult to improve hand hygiene in settings where hands may not be visibly soiled, yet still need disinfection, even in the home environment.[13]

The mismatch between expressed intentions and the actual behavior of the participants in this study is similar to the now widely accepted belief that certain processes that determine behavior are unconscious.[13] Unconsciousness or unconscious influence has recently been defined as "a lack of awareness regarding the influences or effects of a triggering stimulus."[14] However, the apparent unconscious behavior exhibited by the participants, such as face-touching behavior or removing their glasses, could be an inherent characteristic of human cognitive decision making, based on the causality between the glasses and eye pain, or skin sensitivity to pressure and pain.[15]

Therefore, not all behaviors are necessarily unconscious. Sax et al., observed nurse hand hygiene within an intensive care unit following participation in simulation-based hand hygiene training a few days earlier and found that when assessing the verbalized attitudes and beliefs against the theory of planned behavior, the nurses would certainly have scored high on intention to act.[16] Moreover, the participants would also respond positively if questioned about social norms in regard to expressed positive beliefs about the outcome of the activity, yet they failed to perform proper hand hygiene and infection prevention strategies.[16] The behavior in question was not obstructed by any of the frequently cited barriers to hand hygiene since time pressure did not appear to be an issue, and hand-rub dispensers were abundant and conveniently located.[13,17] Similar outcomes would be assumed of the students in this study in regard to self-inoculation risks from face-touching behavior. Both groups of students have undergone training and would have scored high on intention to act, based on their verbalized attitudes and positive beliefs regarding the outcomes of infection prevention. However, the face-touching behaviors of the participants were observed frequently, which could present significant risk factors for pathogen transfer and infection.

One reason face-touching may be a difficult habit to correct is due to the soothing effect of touching the face where the trigeminal and facial nerves are close to the surface (for example, the supraorbital nerve of the trigeminal at the supraorbital foramen, and the suborbital nerve of the trigeminal at the suborbital foramen). These points have been used in alternative and complementary medicine (acupressure, acupuncture, tapping) for relief of pain and stress. Perhaps increasing awareness of the underlying aspects of these habits will be beneficial in avoidance of face-touching behavior in a clinical setting.

Unsafe behaviors committed unconsciously may be corrected with the proper mental model. Creating mental models allows individuals to make inferences about the outcome of future events based on their previous experiences with similar events.[13] Researchers have suggested a pragmatic approach for behavioral change, the Easy, Attractive, Social, and Timely (EASY) model, that addresses face-touching behavior.[18] One simple suggestion is to provide tissues in convenient locations so that fingers or hands are not needed to touch the face.[18] Another suggested application of the framework is to advance the social acceptability of using one's sleeve to touch the face.[18] Healthcare workers can be "primed" with certain cues that automatically activate relevant mental models and elicit relevant behavior.[14]

If health care workers were to visualize the connection between behavior and outcome or given immediate feedback following an unsafe behavior, then unsafe behaviors that promote faulty mental models would no longer be viewed as harmless.[13] Furthermore, short-term training in and of itself may not suffice for long-term behavior change. Educational principles recommend reinforcement and overlearning of behaviors.[19] Most large medical/dental facilities, along with credentialing and licensing agencies, recognize the importance of reviewing and updating infection control practices and have requirements in place for ongoing continuing education.[20] Future research is needed to determine evidence-based educational strategies for behavioral changes that have positive implications for the reduction of disease transmission for both health care providers and patients.

This study had limitations. Participants were from two courses in one university and the small sample size reduced the generalizability of the findings. However, the small sample size was free from non-response bias as all students taking the exam were part of the study. Videos for this study were from an off-campus examination location and were recorded outside of the health care setting. Test taking is a stressful activity and unconscious face-touching behavior

might be different during such a stressful situation. However, the finding of high frequency of face-touching behavior is of concern, given that the study participants are future health care providers who had completed required infection control educational modules specifically addressing COVID-19 transmission factors. Future studies should take place on the clinic floor in educational settings.

Conclusion

It is general knowledge that the hands may touch objects that may be contaminated and have the potential to transfer pathogens to oneself and to others as well as self-inoculation. The high incidence of face-touching behaviors observed in dental and dental hygiene students in a non-clinical setting may indicate the transfer of pathogens from these behaviors may not be considered consciously. Given the significance of the COVID-19 pandemic and the recommendations for prevention of the spread of disease, avoidance of face-touching has become an important public health message and a behavior for health care providers to model for their patients.

Disclosure

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Examining the Role of HPV Communication Training in the Knowledge, Attitudes, Comfort, and Confidence of Dental Hygiene Students

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Abstract

Purpose: Human papillomavirus-positive oropharyngeal cancer (HPV-OPC) is the most common HPV-associated cancer. The purpose of this study was to explore the role of a curriculum that utilized brief motivational interviewing (BMI) strategies on the knowledge, attitudes, comfort, and confidence of dental hygiene students regarding communication about HPV.

Methods: Junior and senior dental hygiene (DH) and dental therapy (DT) students participated in this retrospective study. Senior students (n=26) were assigned to the control group while junior students (n=31) were assigned to the intervention group. Both groups completed an online HPV education module. The intervention group was trained in BMI techniques for communication on HPV while the control group did not receive any additional guidance. Both groups were required to have HPV discussions with two patients. Pre-test/post-test questionnaires were administered via an online software program for each patient encounter. Descriptive statistics were used to analyze the data.

Results: Thirty-one intervention group and 26 control group participants completed the pre- and post-test quizzes and questionnaires. While knowledge improved for both groups from pre-test to post-test one (+5.3 % correct, p=0.001) and post-test two (+3.2, p=0.04) it was not statistically significant Attitude scores were higher in the control group at post-test one (3.25 vs 3.01, p=0.07) and post-test two (3.14 vs 2.91, p=0.05). Confidence was higher in the control group at post-test one (3.16 vs 2.82, p=0.05) and post-test two (3.21 vs 2.69, p=0.006). Comfort was higher in the control group at post-test one (3.16 vs 2.56, p=0.002) but not at post-test two (2.65 vs 2.83, p=0.45).

Conclusion: Results from this study suggest that dental hygiene education programs should include didactic instruction on HPV, the use of BMI strategies, as well as multiple opportunities to practice HPV related conversations to improve student knowledge, attitudes, comfort, and confidence levels. Interactive continuing education programs with a focus on HPV and BMI techniques can also assist oral health care providers in the delivery of provider-patient communication on HPV.

Keywords: human papillomavirus, sexually transmitted infections, HPV vaccine, communication skills, brief motivational interviewing, dental hygiene education

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted disease and is responsible for most cervical, anal, and oropharyngeal cancers.[1,2] Human papillomavirus infections are asymptomatic and although the immune system clears 80% of HPV infections within a year, persistent infections can progress to cancer after many years.[1,3] Unlike cervical cancer, early detection and screening for human papillomavirus-positive oropharyngeal cancer (HPV-OPC) is difficult, owing to the lack of a presenting lesion and limited visibility at the base of the tongue, soft palate, and tonsillar crypts.[1] Consequently, HPV-OPC is now the most common HPV-associated cancer.[4]

Although a safe, effective prophylactic vaccine against oncogenic HPV types has been available and recommended

for adolescents since 2006, uptake of the vaccine in the United States (US) has been slow.[2,5,6] Data show a 48.6% vaccine completion rate for adolescents ages 13-17, falling short of the national goal of 80%.[2,7] Additionally, catch-up vaccines are available up to age 45 to extend protection against infection for at-risk older age groups.[8]

Recommendations by health care providers have shown to be the most influential factor in vaccine uptake, yet providers report a lack in the skills, comfort, and confidence in HPV communication.[9,10] Effective patient-provider communication can be difficult without provider training.[9,11,12] Malo et al. found that providers' attitudes, subjective norms, and perceived self-efficacy improved post-training, facilitating improved provider HPV communication.[11]

Dental providers understand the important role they play in the reduction of HPV-OPC.[13] Prevention efforts by primary dental providers have historically focused on secondary and tertiary prevention through screening and referrals. Recently, policy statements issued by the American Dental Association (ADA) and American Academy of Pediatric Dentistry (AAPD) encourage dental providers to expand their HPV prevention efforts to include primary prevention activities, such as patient education and immunization advocacy.[14,15] However, research has shown that few dental providers discuss the role of HPV in oropharyngeal cancer or provide vaccine counseling for patients. [2,16,17,18] Dental providers have reported several barriers to HPV communication, including discomfort in discussing a sensitive topic and a lack of knowledge, training, and confidence.[2,5,16,17,18] Conversely, parents of adolescents have reported comfort in having HPV discussions with their dental provider, given the role of HPV in oropharyngeal cancer.[19] This finding may encourage comfort and confidence among dental providers in having HPV discussions with patients. Although some dentists and dental hygienists have reported receiving HPV information during their formal education, the information had little practical value.[13,18] Focused training in HPV communication strategies is rare. A survey of dental hygiene program directors found that the majority of programs spend less than two hours on HPV didactic content, with few programs (14.4%) assessing students' HPV communication skills during patient encounters.[20] However, dental providers are trained in collaborative patient-centered communication strategies aimed at behavior change which also may be helpful in HPV counseling.

Motivational interviewing (MI) is a collaborative, patient-centered counseling approach to support intrinsic motivation.[21] Training in MI has been found effective in improving the knowledge, skills, comfort, and confidence of providers during difficult conversations with patients related to various health conditions including weight management, tobacco cessation, chemical dependency, and oral health.[22,23,24] Motivational interviewing has been shown to be effective in facilitating HPV conversations and increasing HPV and non-HPV vaccine uptake in medical settings.[10] Given the HPV patient-provider communication barriers cited in the literature, MI stands out as an evidence-based counseling approach for dental providers during HPV-OPC and HPV vaccine uptake conversations.[2,5,16,17,18]

One challenge with the inclusion of MI in the dental setting is limited time.[24,25,26] However, brief motivational interviewing (BMI) is intended for providers with limited time of 5-15 minutes and is designed to collaborate with patients to assess motives, raise awareness, and support change.[27] Dental professionals often have less than 15 minutes during a patient care visit to discuss behaviors that contribute to oral diseases, such as HPV.[27,26,27] Reno et al. reported providers who used BMI perceived it as more effective than other communication strategies to address vaccine hesitancy.[10] More importantly, providers reported BMI compelled them to practice active listening thus empowering parents in shared decision-making.[10] Brief motivational interviewing may be a useful communication strategy for assessing patient motivations for prevention of HPV-OPC, raising HPV vaccine awareness, and supporting change in high-risk behaviors associated with HPV-OPC.

Motivational interviewing has been a key component of the dental hygiene patient communication curriculum for the past decade.[26,28,29] Dental hygiene students educated in MI counseling are familiar with its principles and guiding strategies that are applicable when discussing sensitive topics including HPV transmission, HPV-OPC, and vaccine uptake. An HPV communication training intervention may reduce barriers and influence dental hygiene students' comfort and self-efficacy in HPV prevention. Limited research has shown that brief educational interventions may improve the knowledge, comfort, and confidence in HPV counseling for oral health care providers,[12,30] however there is a gap in the literature regarding the role of an experiential HPV communication training program on oral health care providers' ability and confidence in executing HPV conversations with patients. In response to this need, the University of Minnesota (UMN) Division of Dental Hygiene implemented an updated HPV curriculum for dental hygiene (DH) and dual degree dental hygiene/dental therapy students (DT) that included an experiential BMI component. The purpose of this retrospective study was to explore the role of an experiential HPV BMI training curriculum on the

knowledge, comfort, confidence, and performance of DH and DT students in HPV communication and vaccine advocacy.

Methods

This study was approved by the UMN Institutional Review Board (STUDY00007617). A retrospective pre-test/post-test with intervention and control groups was used to assess an enhanced HPV BMI training curriculum in the UMN Division of Dental Hygiene program. The theory of planned behavior provided the framework for integrating the HPV curriculum into the bachelor's degree program to improve students' confidence regarding HPV communication. This theory posits that the adoption of a behavior is influenced by a person's attitude toward the behavior, the perception of subjective norms regarding the behavior, and the person's confidence (self-efficacy) in performing the behavior.[31]

University of Minnesota dental hygiene student cohorts are comprised of DH and DH/DT dual degree students; both student groups complete the entire dental hygiene curriculum. The intervention group was comprised of junior students (DH3, DT3); senior students (DH4, DT4) served as the control group. All HPV and BMI content quizzes and questionnaires were course requirements. The UMN IRB did not require consent to participate due to details of the enhanced HPV BMI training curriculum provided in the course syllabus. Both groups completed an online 40-minute HPV communication training module. Content included general HPV information, the role of HPV in OPC, and HPV vaccination facts. In addition, the intervention group completed a 90-minute, face to face, role-playing session using BMI techniques for HPV communication strategies. Peer and faculty feedback were given during and immediately following the role-play session. Both groups were required to have HPV discussions with two patients and were provided with HPV fact sheets to facilitate patient conversations.

The intervention group demonstrated their BMI communication training during two audio-recorded HPV patient conversation assignments in the UMN School of Dentistry (SoD) clinics as part of the clinical applications course (semester 3). Students used BMI communication skills to assess adult patients' knowledge of general HPV information, the role of HPV in OPC, and readiness to discuss HPV vaccination with their physician and later listened to their two audio-recorded patient interactions and self-assessed. Faculty feedback was also provided after each patient interaction.

Students in the control group completed two required patient HPV interactions as part of their clinical applications course (semester 6). No faculty feedback was given to these students on their HPV patient interactions. The control group had previously completed MI and BMI training within the UMN curriculum, and their MI strategies had been evaluated previously during three Objective Structured Clinical Examinations (semesters 3,4,5).

Prior to completing the online HPV communication training module, both groups completed a quiz on their HPV knowledge and a questionnaire assessing attitudes, comfort, and confidence in HPV communication (pre-test one). The intervention group completed the same quiz and questionnaire immediately following the training module (post-test one) and again following two patient interactions (post-test two). Whereas, the control group completed the same quiz following two patient interactions only. Additionally, the intervention group completed a second questionnaire specifically addressing confidence and comfort in using BMI for conversations regarding HPV immediately following the role-playing session and following two patient interactions.

Instruments

Demographic information collected included age, gender, race, and highest level of education. A 50-item True/False, faculty created quiz was used to assess students' HPV knowledge prior to and following the online HPV course. A previously used attitude, comfort and confidence questionnaire that assessed the knowledge attitudes, and practices of HPV communication and vaccine advocacy among Minnesota dentists and dental hygienists was used with permission from Stull and Lunos.[17] Modifications were made to assess attitudes of DH and DT students regarding HPV communication with patients. The questionnaire included seventeen Likert-type items on a four-point scale.

A second series of three instruments was used to assess the intervention group regarding the use of BMI to enhance comfort and confidence for HPV communication. A total of three previously used questionnaires from the University of Missouri-Kansas City and the University of Michigan were modified with permission to include HPV and HPV vaccine content assessing the comfort and confidence in using BMI for patient communication.[24] The HPV BMI pre-test instrument was administered immediately prior to the BMI training and included 24 Likert-type items on a six-point scale. Two additional questionnaires were delivered. Post-test one was delivered immediately after the BMI role-playing and post-test two was delivered following the completion of two patient encounters. Post-test one and post-test two each consisted of 30 items. The knowledge quiz and questionnaires

were pilot-tested by six dental hygiene faculty members to establish face and content validity; minor modifications were made to improve clarity.

Knowledge, attitude, confidence, and comfort calculations

Participants took a 50-item knowledge quiz at three separate timepoints. Knowledge scores in the control and intervention groups for pre-test quiz (before 40-minute online educational module), post-test quiz one (immediately following HPV education module), and post-test quiz two (after two patient interactions) were calculated as the percentage of correct answers on the knowledge quiz.

Attitude scores at each time point were calculated as the mean of the 17 items (4-point Likert scale) on the attitude questionnaire (with two items of opposite valence reverse-coded prior to averaging) such that a higher attitude score represents a more favorable attitude. Confidence and comfort scores were calculated similarly at each time point, using a subset of three attitude items pertaining to confidence and one attitude item pertaining to comfort, such that higher scores correspond to greater confidence and comfort.

Separate BMI confidence and BMI comfort scores were calculated in the intervention group only, using responses (6-point Likert scale) to the BMI instrument. Brief motivational interviewing confidence at each time point was calculated as the mean of the four confidence-related questions, and BMI comfort at the post-test one and two time points was calculated as the mean of two comfort-related questions, with higher scores representing greater confidence and comfort. A survey software program (Qualtrics; Provo, UT, USA) was used for data collection.

Statistical analysis

Knowledge, attitude, confidence, and comfort scores were compared between control and intervention groups at each time point using two-sample *t*-tests. Scores were compared within groups between the pre-test and post-tests one and two time points using linear models. Demographic characteristics were compared between groups using Fisher's exact tests. Scores are summarized as mean ± standard deviation, and categorical characteristics are summarized using rates. Analyses were conducted using statistical software (R version 3.6.1, R Foundation for Statistical Computing; Vienna, AT). A two-sided p-value less than 0.05 was regarded as statistically significant.

Results

All students in the intervention group (n=31) completed six instruments administered at three different time points. All students from the control group (n=26) completed the 50-item quiz and the three questionnaires administered at three different time points. Education level differed between groups (p=0.008), with higher levels of education in the control group. Demographics are shown in Table I.

Table I. Participant demographics (n=57)

Characteristic	DH3/DT3 (n=31)	DH4/DT4 (n=26)	*p*-value
	n (%)	n (%)	
Age			**0.78**
19-22	18 (58.0)	12 (46.0)	
23-26	8 (26.0)	7 (27.0)	
27+	3 (10.0)	3 (12.0)	
Age not given	2 (6.0)	4 (15.0)	
Gender			**0.04**
Female	31 (100.0)	22 (85.0)	
Male	—	4 (15.0)	
Race			**0.19**
Hispanic /Latino	2 (6.0)	4 (15.0)	
Black/African-American	3 (10.0)	4 (15.0)	
Native American/Alaskan Native	—	1 (4.0)	
Asian	7 (23.0)	2 (8.0)	
White	19 (61.0)	13 (50.0)	
Missing	—	2 (8.0)	
Education			**0.008**
Some college, no degree	19 (61.0)	6 (23.0)	
Associate degree	2 (6.0)	2 (8.0)	
Bachelor degree	10 (32.0)	17 (65.0)	
Graduate degree	—	1 (4.0)	

Mean knowledge scores for both cohorts improved from pre-test to post-test two. The control group mean knowledge scores (pre-test 81.7±6.1; post-test one 87.4±4.2; post-test two 84.3±6.8) tended to be higher than the intervention group scores across all time points, although not statistically significant. Knowledge, attitudes, confidence, and comfort scores between cohorts at three time points is shown in Table II.

Difference in mean pre-test attitude scores between control (3.01±0.44) and intervention (3.02±0.37) groups was not statistically significant (p=0.91). Differences in mean post-test one attitude

Table II. Knowledge, attitudes, confidence, and comfort means at three time points (n=57)

	DH3/DT3 (n=31)	DH4/DT4 (n=26)	
Domain	**Mean SD**	**Mean SD**	***p*-value***
HPV Knowledge			
Pre-Test	79.9 ± 6.7	81.7 ± 6.1	0.28
Post-Test 1	84.8 ± 11.2	87.4 ± 4.2	0.26
Post-Test 2	83.7 ± 11.2	84.3 ± 6.8	0.82
HPV Attitudes			
Pre-Test	3.02 ± 0.37	3.01 ± 0.44	0.91
Post-Test 1	3.01 ± 0.47	3.25 ± 0.46	0.07*
Post-Test 2	2.91 ± 0.45	3.14 ± 0.46	0.05*
HPV Confidence			
Pre-Test	2.56 ± 0.83	2.78 ± 0.68	0.28
Post-Test 1	2.82 ± 0.65	3.16 ± 0.65	0.05*
Post-Test 2	2.69 ± 0.78	3.21 ± 0.57	0.006*
HPV Comfort			
Pre-Test	2.97 ± 0.87	2.69 ± 0.74	0.21
Post-Test 1	2.56 ± 0.75	3.16 ± 0.62	0.002*
Post-Test 2	2.83 ± 0.85	2.65 ± 1.02	0.45

**p* values are from two sample t-tests and Fisher's exact tests for the categorical measures. $p \leq 0.05$

scores between control (3.25±0.46) and intervention (3.01±.0.47) and mean post-test two attitude scores between control (3.14±0.46) and intervention (2.91±0.45) were statistically significant (p=0.07, 0.05).

Differences in confidence scores between intervention and control groups were explored by analyzing responses to confidence questions in the attitude questionnaire. Mean pre-test scores did not differ significantly (p=0.28) between the control group (2.78±0.68) and intervention group (2.56±0.83). Statistically significant differences (p=0.05, 0.006) were found in mean scores (post-test one) between control (3.16±0.65) and intervention (2.82±0.65) groups and for mean scores (post-test two) between control (3.21±0.57) and intervention (2.69±0.78) groups; with lower scores indicating weaker confidence.

Mean pre-test comfort scores from the attitude questionnaire between groups were similar (control group 2.69±0.74; intervention group 2.97±0.87; p=0.21). A statistically significant difference (p=0.002) in mean scores (post-test one) was found between control (3.16±0.62) and intervention (2.56±0.75) groups, with higher scores indicating more comfort. Mean post-test two scores were similar between control (2.65±1.02) and intervention (2.83±0.85) groups (p=0.45). Comfort improved (pre-test to post-test one) in the control group (+0.47, p=0.04) and declined in the intervention group (–0.41, p=0.05). However, comfort at posttest 2 did not differ significantly from pretest in either group (–0.04, p=0.87; –0.16, p=0.50). Figure 1 shows differences in comfort discussing HPV and HPV vaccination between groups and across all timepoints.

Confidence and comfort applying BMI during HPV conversations were measured at three time points in the intervention group (Table III). The mean confidences scores were agreeable over all three time points with no statistically significant change over time. Comfort mean scores were consistent over all time points with no statistically significant change.

Figure 1. Level of comfort discussing HPV with patients across three time points (n=57)

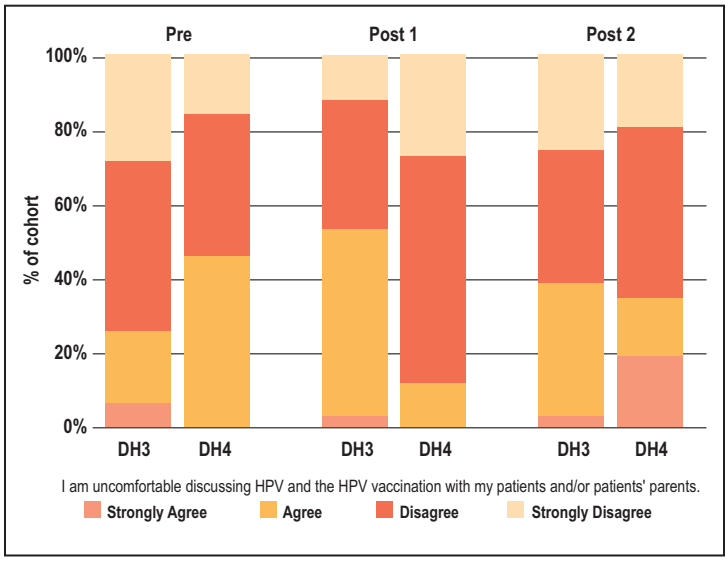

Table III. Changes in Confidence and Comfort in using BMI in the intervention group across three time points (n=31)

Instrument	Time point	Mean SD	*p*-value*	*p*-value*
MI Confidence	Pre-Test	5.37 ± 0.73	—	—
	Post-Test one	5.46 ± 0.55	0.55	—
	Post-Test two	5.52 ± 0.54	0.33	0.72
MI Comfort	Pre-Test	—	—	—
	Post-Test one	5.05 ± 0.73	—	—
	Post-Test two	4.83 ± 0.91	—	0.30

**p* values are from two sample t-tests and Fisher's exact tests for the categorical measures. $p \leq 0.05$

Discussion

While carcinogen-induced head and neck cancers have declined in recent years, the incidence of HPV-associated OPC continues to increase.[32] Oral health care providers recognize their role in HPV prevention, yet they report barriers to HPV discussions with patients.[17] Professional education and training in communication techniques may prepare oral health care providers with more comfort and confidence to discuss HPV with patients. This study explored the role of an experiential HPV communication training curriculum using BMI on the knowledge, attitudes, confidence, comfort of DH and DT students in HPV communication and vaccine advocacy.

All participants were assigned the same 40-minute HPV online educational module at the beginning of the second semester in the academic year. Students in the intervention group (DH3 and DT3) received additional BMI training to enhance HPV communication skills, while students in the control group (DH4 and DT4) were in their last semester of education and were assigned the HPV educational module only. As the UMN includes the use of MI and BMI throughout the curriculum, the control group did not receive any specific training on the application of BMI to HPV communication strategies.

General knowledge scores regarding HPV, HPV-OPC, and HPV vaccination improved for both groups at the post-test immediately following the educational online module, consistent with previous research conducted regarding dental hygiene students' knowledge and confidence after completing an online education program on HPV-related content.[30] However the knowledge scores in this study decreased slightly following the second patient interaction, suggesting that a one-time educational module is not sufficient to sustain high levels of knowledge over time. Repeated educational sessions may be necessary to clarify, confirm, and activate previously learned HPV information to strengthen knowledge.[33]

Attitudes toward their roles as oral health care providers in HPV prevention were high at the pre-test and remained high following the HPV communication curriculum, with little change. In comparison, Malo et al. reported improved attitudes of medical providers following HPV vaccination conversation training.[11] In this study, the favorable attitudes coupled with increased confidence in HPV conversations, supports HPV communication training to facilitate the HPV counseling practices of future oral health care providers. Applying the theory of planned behavior (TPB), favorable attitudes and improved provider confidence may facilitate effective HPV communication.[31] However, participants also reported wanting further training and practice in HPV communication. Several participants recommended videos of exemplar HPV conversations in the open-ended responses. These comments support the TBP constructs of perceived power and perceived behavioral control.[31] In order to facilitate HPV communication in practice (perceived behavioral control), one needs further training to be empowered.[31]

Confidence levels in discussing HPV with patients improved following the HPV education module for both groups, although confidence was higher for the control group. This may be explained by several confounding factors. Participants in the control group were in their final semester of the DH program and may possess more confidence in their clinical and patient communication skills. Conversely, participants in the intervention group were in their third semester of the dental hygiene program and did not have as much clinical and communication experience with patients. Further, participants in the control group had been practicing BMI with patients for five semesters, had been evaluated in Objective Structured Clinical Exams, and had received faculty feedback during clinical care.

Research has shown that DH students' confidence in their MI skills develops over time and improves with faculty feedback.[24,29] Practicing clinicians have also reported on the importance of ongoing training to maintain MI skills.[34] Following the second patient interaction, participants in the intervention group students were asked to identify the challenges they experienced during the HPV discussions with patients. Responses fell into two categories: 1) inexperience in BMI technique and 2) lack of confidence in HPV knowledge. Confidence levels may improve with additional BMI training, including faculty feedback and coaching. Based on the knowledge declines that were found at post-test two, an educational module reviewing HPV information, the role of HPV in OPC, and HPV vaccination advocacy may be beneficial.

Although the HPV patient BMI conversations were short (less than five minutes), the confidence level of novice students in the intervention group may have been influenced by the pressure of overall time management considering they were in their second semester of providing patient care. Practicing dental hygienists have reported increased confidence in using MI conversations during clinical care appointments as they became more efficient in time management.[34]

Comfort levels in the intervention group regarding HPV conversations did not improve following at the conclusion of two patient interactions. This finding may be explained by an idealistic, overconfident attitude of beginning students prior to actual patient interactions. Findings from this study are

similar to Bray et al. who reported a slight decrease in student confidence in using MI for behavior change counseling following MI training sessions.[28] Alternatively, other research has shown DH students' comfort and confidence in HPV counseling improved after receiving HPV education in an online format.[30] Audio recording patient interactions for instructors and self-evaluation may have also contributed to the lack of comfort in the intervention group. Audio recording patient conversations is unnatural and students may have been nervous asking patients' permission to record the conversation, particularly regarding a sensitive topic.

This study had limitations. The instruments used in this study were modified from existing questionnaires, and validity was not established. The use of a convenience sample may lead to sampling bias and the results from this study cannot be generalized to other student groups or practicing oral health care professionals. The DH3 and DT3 students' lack of confidence in using a newly learned communication strategy (BMI) may have influenced their responses. Lastly, the aim of data collection was to explore feasibility of an updated HPV curriculum to inform future curricular and research efforts. Therefore, data was unpaired to maintain student anonymity while collecting descriptive statistics. Future studies should be designed to collect paired data to assess influence of an educational intervention on dental hygienists' knowledge, attitudes, confidence, and comfort in HPV communication.

Conclusion

Results from this study suggest that dental hygiene education programs should include didactic instruction on HPV, the use of BMI strategies, as well as multiple opportunities to practice HPV related conversations with the opportunity for faculty feedback to improve student knowledge, attitudes, comfort, and confidence levels. First year DH and DT students may lack the necessary clinical or communication skills to fully benefit from HPV BMI training. Education programs may want to consider implementing HPV BMI training in the students' senior year when they are more confident in their clinical and patient management skills. Interactive continuing education programs with a focus on HPV and BMI techniques can also assist oral health care providers in the delivery of provider-patient communication on HPV.

Disclosure

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Transition to a Competency-informed Dental Hygiene Clinical Evaluation System

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Abstract

Purpose: Competency-informed clinical education includes rigorous and specific performance outcomes with an emphasis on demonstrated outcomes. The purpose of this study was to assess faculty and dental hygiene (DH) student perceptions and elicit feedback regarding the transition to a competency-informed clinical evaluation model in the DH program at the University of North Carolina Adams School of Dentistry for the purpose of continuous quality improvement.

Methods: A mixed-methods approach was utilized to survey senior DH student (n = 36) and clinical DH faculty (n = 15) during the 2018 -19 academic year. Cohort-specific surveys included demographics, Likert-scale questions, and open-ended questions to gauge perceptions of the new system. Two debriefing sessions were held, one for faculty and one for students, to provide open feedback and expand discussions. Survey responses were compared using descriptive statistics. Open-ended responses and debriefing comments were reviewed to identify common themes.

Results: All senior DH students (n=36) and two-thirds of the faculty (67%, n=10) completed the survey. Findings revealed an overall preference to the new evaluation system and indicated that it was a more accurate reflection of clinical performance. Open-ended and debriefing comments revealed an increased quantity and quality of faculty feedback with an emphasis on patient-centered care, rather than a grade-based focus. Students reported decreased stress levels regarding asking clinical care questions and grade outcomes. While improvement in faculty calibration was reported, students also noted a need for continued calibration.

Conclusions: Surveys and debriefing sessions revealed areas of strengths and challenges in a competency-informed clinical evaluation system. Transitioning to a competency-based system provided an environment that is conducive to learning and patient-centered care rather than focused on grades.

Keywords: dental hygiene education, clinical competencies, clinical education, patient centered care, clinical evaluation

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Introduction

Dental hygiene programs are transforming their educational experiences to prepare future oral health care providers for the challenges of a disruptive health care environment.[1] This transformation must occur in a response to ongoing changes in clinical practice and educational environments as well as the accreditation standards from the Commission on Dental Accreditation (CODA).[2,3] Methods of clinical evaluation must also be taken into consideration when looking at educating graduates who are competent health care providers.

Grades have traditionally been used for student motivation; however, grades may have the opposite effect and be in direct competition with learning outcomes.[4] Grades may demotivate learners and potentially reduce interest in learning, desire for challenging tasks, and the quality of the thought process.[4] When considering the impact of grades on student well-being, health professional schools are investigating and transitioning to a pass/fail grading system.[5,6] Pass/fail systems, particularly in medical institutions, are shown to reduce stress[6] and depression,[5] promote less competition between peers, and foster deeper learning.[7] White and Fantone found that medical students in programs using a three-tier or higher grading system reported higher levels of stress, emotional exhaustion, burnout, and depersonalization.[8] By contrast, other studies

found that students in schools with a pass/fail system reported a more positive well-being, reduced stress, and depression, while still ensuring the integrity of technical skill, evidence-based practice, and professionalism.[5]

Competency-informed clinical education includes performance outcomes that are specific and rigorous with an emphasis on demonstrated outcomes.[9] Advantages of competency-informed education programs include a focus on individual abilities and needs, objectives, efficiency, and improved use of feedback.[9] Competency-informed education was introduced in dental education by CODA dating back to 1995. Competencies can serve to guide changes in student learning methods and restructuring of clinical evaluation systems.[10]

As the dental hygiene (DH) program at the University of North Carolina (UNC) Adams School of Dentistry was undergoing curricular modifications,[11] the opportunity arose to transition the DH clinical evaluation system from a requirements-based system to a competency-informed system. The traditional, requirement-based system consisted of a five-tier number grading system that translated into a letter grade. The 1-5 grading system was used daily to evaluate student clinical performance. However, this system had shortcomings for both students and faculty. The subjective components were often difficult to calibrate leading to grade inflation and student frustration. Students frequently focused on the daily grade and often overlooked aspects of patient care, ultimately impacting the learning experience and patient care outcomes. Faculty were also impacted by the grading system by assigning grades to students that were not necessarily earned. The high number of daily clinical evaluation grades at the end of the semester also diluted the integrity of the evaluation process and the quality of feedback.

The UNC DH faculty were interested in creating and implementing a less traditional method of clinical evaluation, specifically pass/fail daily grading, that would not compromise student academic performance or the integrity of evaluation. A pass/fail daily grading system would help eliminate grade inflation, and more importantly shift the overall clinical experience from being grade-centered to patient-centered. The implementation of a two-tier evaluation system also aligns with the current shift in dental and DH programs to a competency-informed education.[7] Jham et al. also reported that the basic motivational shift from the grade itself, could be a positive aspect of a pass/fail system.[7] With the development of a pass/fail system for the UNC DH program, the goal was to diminish student feelings of threat in the clinics, reduce faculty stress levels in a graded situation, enhance the faculty/student relationships and environment to foster collegiality, and bring education to the forefront of all clinical activities.[8] Further, daily evaluations were transitioned to competencies for all procedures and skills and these competencies became the graded portion of the clinical course. The purpose of this quality improvement study was to assess faculty and student perceptions and feedback on the new clinical evaluation system to guide future changes.

Methods

A mixed methods approach was utilized to gain feedback from faculty and students of the new clinical evaluation system. Second-year DH students (n=36) and DH clinical faculty (n=15) at UNC were recruited for this study following the fall semester in December 2018. Inclusion criteria were DH students and DH faculty who had experienced both the previous and the new evaluation system. The study was given exempt status by the UNC Chapel Hill Office of Human Research Ethics.

The new evaluation system was developed over the summer of 2018 when DH clinics were not in session. Competencies were developed by the clinical directors for the various procedures (e.g. adult prophylaxis) based on CODA standards for DH programs.[2] A centralized tracking method was developed for logging student experiences course of the year. The dental hygiene patient care coordinator audited the clinical notes to ensure the accuracy of the logged experiences. A separate day-long faculty calibration and student orientation was completed to review the new system and student/faculty expectations prior to beginning the fall semester 2018. A comparison of the two clinical evaluation systems is shown in Table I.

Table I. Comparison of requirement-based versus competency based clinical evaluation systems

	Previous system	New system
Components	**Requirements-based**	**Competency-informed**
Grades	Daily Grade = 1-5 Abundance of daily grades averaged for clinic course grade (daily session grades) Based on major/minor error list	Daily Grade = pass/fail Numerical grades from competencies and skills sheets averaged for clinic course grade Based on competency rubrics and skill sheets
Daily Tracking Forms	Track student errors and daily grades	Track student's progress after each session

Survey instrument

Senior DH students (n=36) and clinical faculty members (n=15) were invited to complete an online survey (Qualtrics; Provo, UT, USA) via email following the conclusion of the fall semester in December 2018. This timing allowed the students and faculty to have experienced one semester of the previous system (spring 2018) and one semester of the revised system.

The survey contained demographic and 14 Likert-type questions. Demographics included age and role (faculty or student). The Likert-type items included 14 statements comparing levels of agreement of the previous and new evaluation systems. A forced Likert-type scale was chosen to gain specific opinions regarding participants' opinions for each statement. Forced response options for each statement were: strongly agree, agree, disagree, and strongly disagree. The survey also included four open-ended questions to allow further elaboration on overall opinion, strengths, weakness, and improvements needed of the new clinical evaluation system. The questionnaire was pilot tested by two recent DH graduates and two non-clinical DH faculty members. Adjustments were made based on feedback from the pilot testers.

Debriefing sessions

Dental hygiene students (n=36) and faculty (n=15) were invited via email to participate in a debriefing session following the completion of the fall semester. Two one-hour debriefing sessions were scheduled: one for DH students and one for clinical faculty, with one facilitator and one note taker. The debriefing session questions included overall thoughts, improvements, and recommendations still needed of the new clinical evaluation system. Debriefing sessions were audio recorded, transcribed by research support staff, and assessed to identify common themes from open-ended responses and debriefing comments.

Data analysis

Quantitative data were aggregated, and descriptive statistics were used to summarize the results (Stata®; College Station, TX, USA). A 2x2 chi-square for independence table was used to calculate agreement between students and faculty for each statement ($p < 0.05$). The four-point Likert scale was collapsed into two categories of agree and disagree. Inductive thematic analysis, [11] through descriptive coding in the first cycle and pattern coding as the second cycle, was utilized for open-ended responses and debriefing session transcripts. This allowed for the generation of categories based on patterns across participants' open-ended responses within the data set of the surveys and debriefing sessions.[12] Inclusion and exclusion criteria, along with definitions, were outlined in a codebook.

Results

Quantitative results

All senior DH students (n=36) and ten clinical faculty members (67.0%, n=10) completed the survey. All DH student participants were female, ranging in age from 21-50 years with an average age of 24.61 years (SD 6.29). The faculty respondents were 24-59 years of age, with an average age of 39.86 years (SD 15.02). Findings revealed that most of the students (81.0%, n=29) and clinical faculty (90.0%, n=9) of preferred the new evaluation system (p=0.4858). A majority of students (83.0%, n=30) and all if the faculty (100%, n=10) agreed the new system enhanced faculty calibration (p=0.6036) and clinical competence (p=0.6036). Eighty-three percent (n=30) of students and 90% (n=9) of faculty agreed the new system fostered a learning-centered environment (p=0.1662). Both groups agreed (77.13%, n=27 DH students; 90.0%, n=9 faculty) agreed the new clinical evaluation system resulted in a more accurate reflection of performance as compared to the previous evaluation system (p=0.3090). Levels of agreement between the two groups on the 14 Likert scale items are shown in Table II. The open-ended responses from the survey were coded in the same manner as the debriefing session and is described within the qualitative findings of this section.

Qualitative findings from open-ended responses and debriefing sessions

Fifteen DH students (n=15) and nine faculty members (n=9) attended either the student or the faculty debriefing session at the conclusion of the fall semester. The findings from the debriefing sessions highlighted the responses from the open-ended questions from the survey. Results from the debriefing sessions included five themes: 1) focus on patient care; 2) increased morale; 3) enhanced feedback; 4) faculty calibration; and 5) too much paperwork. Representative quotes from the qualitative themes are shown in Table III.

General impressions

When asked about overall thoughts to the new clinical evaluation system, student participants focused primarily on shifts in focus and feedback, while faculty participants focused on logistics. Students noted that compared to the previous system, the new system had more focus on patient care and less focus on grades. Further, students stated that they felt more comfort in receiving constructive feedback.

Faculty noticed a shift in students being less 'grade-focused' to more 'learner focused' and that students appeared to ask more questions. However, faculty participants also noted the new system seemed like too much paperwork and

Table II. Level of agreement comparing clinical evaluation systems (n=46)

	Student Responses (n=36)	Faculty Responses (n=10)	*p*-value
Statement	**n(%)**	**n(%)**	
The revised clinical evaluation system is easy to comprehend.	31 (86.11)	10(100)	0.2119
The revised clinical evaluation system improves the students' time efficiency during clinic.	31(86.11)	8(80.0)	0.6341
The revised clinical evaluation system accurately assesses clinical competence.	30(83.33)	9(90.0)	0.6036
The revised clinical evaluation system is a more accurate reflection of student performance compared to the previous clinical evaluation system.	21(77.13)	9(90.0)	0.3090
The revised clinical evaluation system accurately identifies student performance deficits.	34(94.4)	10(100)	0.4460
The revised clinical evaluation system adequately assesses professionalism.	31(86.11)	7(70.0)	0.2344
The revised clinical evaluation system adequately assesses ethical considerations in patient care.	33(91.7)	10(100)	0.3451
The revised clinical evaluation system is too rigorous.	13(36.11)	1(10.0)	0.1124
The revised clinical evaluation system improves faculty calibration for grading.	30(83.33)	9(90.0)	0.6036
The revised clinical evaluation system improves faculty time management in clinic.	23(63.89)	8(80.0)	0.3362
The revised clinical evaluation system provides adequate feedback to improve student performance.	34(94.44)	10(100)	0.4460
The revised clinical evaluation system is valuable.	28(78.78)	10(100)	0.1010
The revised clinical evaluation system fosters an environment focused on learning more than grading.	30(83.33)	10(100)	0.1662
I prefer the revised clinical evaluation system compared to the previous clinical evaluation system.	29(80.56)	9(90.0)	0.4858

commented on the additional time needed to complete the various forms. One faculty expressed difficulties in adjusting to the transition and was not in favor of moving away from daily grades expressing having a hard adjustment and did not agree with moving to the pass/fail system.

System improvements

Students and faculty remarked on the improved communication between one another and a reduction in nerves, anxiety and perceived stress levels. Students discussed the enhanced clinical environment leading to a shift from a mindset of perfectionism to a mindset of growth. Further, students noted that the new clinical evaluation system provided an environment that allowed for increased self-improvement and less comparison to other peers. One participant noted that the pass/fail system seemed comparable to private practice. Students discussed feeling like they could ask questions to faculty without fear of being penalized. Due to the safer clinical environment, students indicated feeling like they provided better patient care.

Faculty noticed students seemed to be less pressured by not having every appointment graded and an increased willingness to experience and embrace learning opportunities. Several faculty members commented that students appeared fearful regarding completing competencies and there were mixed opinions regarding students' fears of accepting failure.

The quality of faculty feedback improved with the new system. Feedback was more specific and comprehensive. Both groups commented on how the documentation simplified the written feedback given and allowed both faculty and students to see trends and consistencies in errors. Faculty also felt that the documentation format

Table III. Identified themes on the new evaluation system from student and faculty debriefing sessions (n=24)

Theme	Description	Sample Quotes
Focus on patient care	Students noticed more focus on patient care ultimately impacting the experience within the clinical setting.	" The new system fostered better time management and patient-centered care. [There is] more focus on patient care and less focus on grades." [Student]
Increased morale	Students felt there was an increase in positive emotions and confidence with the new system. Faculty noted that students were more comfortable in the clinical setting.	"There were times with the old system that the grade negatively impacted self-worth, emotions, and feelings about self-confidence." [Student] "Students were more open to asking questions as they did not feel like their grade was deducted."[Faculty]
Enhanced feedback	Students and faculty felt that verbal and written feedback improved in the new system. There was enhanced dialogue between students and faculty that enriched the learning experience.	"I wasn't afraid to make a mistake and I was more receptive to constructive criticism." [Student] "It takes the students' focus off of getting a certain numerical grade…they are more open to feedback." [Faculty] "Documentation allows invitations to collect feedback during the appointment to be easily summarized with students at the end of appointment or competency for comprehensive feedback." [Faculty]
Faculty calibration	Students felt faculty calibration was better, yet improvements still needed. Faculty opinions on calibration were different stating that they felt there was an increase in objectivity yet requested need for clearer expectations.	"You learned to adapt to each instructor's needs. You are changing what you do to impress them and tailor to what they like and what they don't like. Trying to please them the entire time. Based on faculty preferences, not based on patient needs. Faculty preferences take precedence over patient needs." [Student] "Faculty calibration has increased in that everyone is using the objective sheet and point system." [Faculty]
Too much paperwork	Faculty shared there was a significant amount of paperwork. Both faculty and students suggested renaming forms and noted the redundancy of forms.	"Faculty were irritated or annoyed by having so many competencies to check" [Student] "Grading sheet and competencies are a lot of paperwork for the instructor to fill out during the appointment for all students. [It] can be time consuming when we need to spend more hands-on time with students." [Faculty]

also allowed for better facilitation of discussion with students at the end of each clinic session. Faculty also noted that students were more inquisitive and engaged in their learning, while students indicated feeling more receptive to receiving feedback and an improved ability to self-assess.

Both groups independently noted perceptions of improvement in faculty calibration. Faculty noted increased objectivity due to the objective list and point system of the new system. Students however had concerns regarding faculty inconsistency and variability in the faculty assessments.

Recommendations

Recommendations to strengthen the new clinical evaluation system focused primarily on changes to documentation and clearer expectations for clinical faculty. Students noted that consideration to rename certain assessments should be

considered and to reduce overlap between competencies. Faculty made suggestions to enhance the daily tracking forms and other logs. Students suggested additional calibration is warranted. Further, one participant commented that faculty should take students seriously when they indicate readiness to complete a competency.

Discussion

The development of an enhanced and effective clinical evaluation model may greatly impact delivery of high-quality learner-focused education. Efficiency of clinical sessions can be increased, therefore maximizing use of time, increasing productivity, and improved delivery of patient care. Patient outcomes may also improve if students are more focused on patient care, rather than grade focused. Clinical evaluation systems designed to follow a competency-informed model rather than a requirements-based model, align with CODA standards[2] and the delivery of patient-centered care.

It is natural to assume that doubts may be raised regarding the value of a clinical competencies and a daily pass/fail evaluation system. One of the faculty participants in this study voiced opposition to the new system during debriefing. Concerns regarding how a pass/fail system can accurately evaluate competency and provide meaningful feedback are understandable and valid. However, these concerns may also be due to fear of the unknown coming from a system that has been steeped in traditional numerical and letter grades. Greater value for the new system may be found through the use of a rubric-based assessment that fosters qualitative, rather than quantitative feedback, while continuing to assess measurable objectives and well-defined clinical competencies.

Faculty calibration is a continual challenge in clinical teaching and inconsistencies may arise in both formative and summative feedback. Full and part-time faculty bring a diversity of experiences into their clinical teaching and insufficient calibration can create confusion and frustration, inhibit student learning, influence students' clinical performance to satisfy an instructor's grading style, and even impact the quality of patient care.[14] Research studies have examined use of various instruments and professional development activities to enhance faculty calibration.[15,16] There is also a shift to develop and include entrustable professional activities (EPA) with competencies to provide an additional, objective evaluation on trust for professional tasks. The use of EPA structured rubrics can enhance calibration among multiple faculties and serve as guiding benchmarks for differentiation of pass/fail evaluations for clinical procedures.[17]

Quality assessment implications

The development and review of a competency-informed pass/fail clinical evaluation system is a critical process for the transformation of any traditional clinical teaching program. As schools explore options for transitioning to a pass/fail evaluation system, knowledge must be gained through research to support evidenced-based data-driven decision making. This quality outcomes assessment improvement study included data points with specific information to evaluate the change impact, make improvements, and calibrate clinical faculty. The outcomes of this study were critical to evaluate teaching and learning outcomes of students, assess calibration of clinical faculty, and support measurement of the overarching goal to improve quality of the clinical DH education at UNC Adams School of Dentistry. This project was also essential in executing the DH program's efforts for continuous quality improvement. Other clinical teaching programs may glean useful take-aways from this systematic approach to include value in a pass/fail assessment system and the need for calibration to ensure quality and efficiency. Continuous quality improvement must be part of each educational program to ensure incorporation of best practices, high-impact change, use of current and data-driven decision making, and follow-up on the quality analysis.

When considering future directions in clinical evaluation systems such as pass/fail, standard setting is warranted in dental hygiene education. The Association of Medical Education in Europe (AMEE) has developed guides for standard setting processes.[18] Dental hygiene education programs also have the discretion to define their own means of what deems a pass or fail in clinical dental hygiene setting. Future studies should compare standards regarding what qualifies as a pass or fail across dental hygiene programs. Another significant consideration is the impact of the coronavirus pandemic on clinical evaluation. Changes were made to the UNC DH program clinical evaluation prior to the onset of the pandemic in 2020. All aspects of dental education were disrupted with the transition to remote or online education and the need to develop flexible teaching and learning options that included pass/fail systems of evaluation.[19] The CODA also recognized the need for the need for alternative clinical education and evaluation models. These conversations will likely continue due to the ongoing impact of the pandemic. Traditional class and clinical teaching environments will continue to evolve to a blended alternative setting with options for diverse teaching, learning, and evaluation strategies.

This study had limitations. Data included small numbers of faculty and students from one institution and was limited to

those impacted by the transition to the new system. The sample size likely was too small to detect any effects between faculty and student responses. Larger numbers would have more generalizability to other cohorts. Another limitation was the four-point Likert scale, due to the potential to distort results by forcing a choice when the participant had no opinion.

Conclusion

A systematic approach to continuous quality improvement provides the opportunity for ongoing enhancement of the elements of clinical evaluation. Transitioning from a requirements-based clinical evaluation system to a competency-informed system revealed an increase in the quantity and quality of faculty feedback that promoted a positive learning experience. Both students and faculty noted an increased emphasis of patient-centered care rather than a focus on student grades. Students preferred the pass-fail grading method and reported decreased stress levels related to grades and were more comfortable asking questions regarding patient care. Feedback from both groups indicated the strengths and improvements related to the competency-informed system. An increased focus on feedback rather than a numerical score/grade demonstrated the development of collegial relationships, a growth mindset, and a patient-centered care environment. Improvements in the delivery and quality of feedback and faculty calibration are still needed.

Disclosure

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Teledentistry: Dental hygiene students' knowledge, attitudes, and curriculum recommendations

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Abstract

Purpose: Research has shown an increase in dental hygiene (DH) students' knowledge and attitudes toward teledentistry (TD) after TD training in states with permissive but not restrictive DH scope of practice policies. The purpose of this study was to identify self-reported knowledge and attitudes regarding TD among the DH students at the University of North Carolina (UNC) at Chapel Hill before and after an educational intervention and student recommendations for TD curriculum placement.

Methods: A faculty presentation and video demonstration, followed by small group discussions and a large group debriefing session were conducted at the UNC Adams School of Dentistry in March 2019. Participants were invited to complete a survey before and after the educational session. McNemar's matched pair test was used to compare the proportion of the participants' pre- and post-test responses.

Results: Survey participants (n=30) included first year and second year DH students. There was significant difference ($p<0.001$) between pre and post self-reported knowledge of TD as well as a significant difference in participant's response ($p= 0.012$) about facilitating consultation with health care specialists through TD in NC. There was a significant difference in favorable responses ($p=0.0394$) that TD could increase reimbursement to dentists to enhance the provision of more services in NC. Students identified didactic courses (43%), simulated cases (47%), and integration into the DH community rotations (66%) as potential ways to incorporate TD into curriculum. Most students (93%) identified DH restricted scope of practice as a barrier to TD implementation in NC.

Conclusion: The educational session resulted in increased self-reported knowledge and demonstrated positive attitudes toward the adoption of TD into multiple facets of DH curriculum. A major barrier to its adoption into practice is the DH restricted scope of practice in NC.

Keywords: teledentistry, dental hygiene students, dental hygiene education, access to care

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Introduction

Teledentistry (TD) is the use of technology to communicate health information, provide oral health care services, screen, and educate remotely between oral health care providers and patients.[1] This dental care delivery system was derived from a larger movement using telehealth technologies in the field of medicine.[1] Historical developments in TD have led to multiple modalities of care including synchronous video conferencing between patient and provider using audiovisual aids, asynchronous store-and-forwarding of collected data to the provider, remote patient monitoring (RPM) of continually collected health data, and information gathered through mobile devices, or mobile health (mHealth).[2]

The United States Department of Health and Human Services highlights that vast oral health disparities exist across the nation, pointing to the need for development of new approaches to dental treatment that address access to care barriers among populations.[3] Consequently, TD has demonstrated its usefulness in answering this national call by significantly impacting the way oral health care is delivered

to disadvantaged populations such as children, prisoners, the elderly and those with intellectual and developmental disabilities who have limited access to traditional dental care.[4-6] There are many examples of dental professionals that have successfully utilized TD to deliver patient care including those in oral medicine, oral and maxillofacial surgery, orthodontics, prosthodontics, endodontics, periodontics, pediatric dentistry, and general dentistry, including allied dental professionals.[7,8] There is also noted evidence of TD being cost-effective due to decreased travel expenses for patients, increased patient care for providers and overall reduced cost of dental neglect through educational and preventive services.[8,9] The validity of TD has been demonstrated through studies covering pediatrics, general dentistry, radiology, endodontics and orthodontics where diagnoses were consistent between TD and in-person visual examinations.[10] While all states and Washington D.C. reimburse providers for at least some form of telemedicine services, only eight states were reimbursing for TD services as of 2019.[11,12] (Note: this does not include COVID-19 policy changes because most are temporary during the declared national state of emergency.) The American Dental Association (ADA) released the first two Current Dental Terminology (CDT) codes addressing TD services in 2017. The availability of these codes may motivate further commercial and government reimbursement for care and services provided through TD.[2]

Teledentistry also holds merit in the formal education of dental professionals at multiple levels of study including entry-level and undergraduate dental hygiene (DH), Doctor of Dental Surgery (DDS), and Doctor of Dental Medicine (DMD) and graduate students.[13-16] However, schools that are currently using TD to train students to meet oral health care needs are located in states (Nebraska, California, Minnesota, and Arizona) that have more permissive policy (accommodating use of TD) regarding scope of practice for dental hygienists and Medicaid reimbursement. Permissive scope of practice allows for expanded functions, general supervision or independent practice protocols, or a DH diagnosis. North Carolina (NC) has a more restrictive climate regarding these same policy matters. For example, NC law does now allow for expanded DH functions and requires most DHs to practice under direct supervision, with general supervision newly granted in 2020 to those who meet strict qualifications.[17,18] The direct supervision regulation does not allow for DHs to use asynchronous TD in a community setting to perform preventive services and have the DDS conduct a remote examination. Therefore, if DHs cannot practice utilizing TD in this manner, they will not experience how to practice with TD during their clinical education. Another example is that in some states, DHs are not permitted to administer local anesthesia. They may learn about pain control methods and theory as part of their education, but do not actually administer local anesthesia as a part of the curriculum.

Some studies have shown an increase in knowledge and attitudes of DDS and DH students after TD training in these more permissive states, however there is little evidence of TD training or resulting increased knowledge or attitude changes in policy restrictive states such as NC. Therefore, the purpose of this study is to fill this gap by identifying the knowledge and attitudes of TD among the DH student population at the University of North Carolina (UNC) at Chapel Hill. A key emphasis was placed on understanding students' perspectives on how TD should be adopted and included into their curriculum.

Methods

Overview

This study (#19-0242) was conducted at UNC Chapel Hill (UNC-CH) was considered exempt by the UNC-CH Institutional Review Board (IRB). A longitudinal mixed methods study was used and incorporated a survey (Qualtrics; Provo, UT, USA), small group discussions, and a large group debriefing session. The intervention consisted of a video of a faculty presentation and synchronous TD demonstration, small group discussions and a large group debriefing session. The data collection process included a pre- and post- intervention survey, and notes from the large group debriefing session. The study population included students enrolled in the first or second year of the DH program at the UNC Adams School of Dentistry (ASoD). Students who did not complete both the pre- and post-intervention surveys or failed to attend the intervention were excluded from analysis.

Intervention

The intervention was a pre-recorded lecture by the Director of Teledentistry at UNC ASoD, Dr. Shaun Matthews. The lecture defined TD and related terms, discussed models of delivery, access to care statistics in NC, and laws governing TD events. The role of DHs using TD while working under general supervision, was emphasized with the example of the evidenced-based, California Virtual Dental Home model[8] and was contrasted with the NC practice act requirement of direct supervision of DHs. A recorded, synchronous, post-operative consultation between a provider and patient was played, and Medicaid reimbursement for TD services was reviewed. Examples of TD's potential use in in the DH curriculum were also presented.

Survey instrument

Survey questions were developed from previously completed studies regarding TD, access to oral health care, and pre-licensure curriculum.[15,16,19] Permission was received from Northern Arizona University to use part of their survey regarding the value of TD in the DH curriculum.[16] All of the surveys had been pilot tested previously, adding to the validity of this study. Pilot testing for both pre-and post- intervention surveys was completed by three DH students who were not attending the TD educational session. Minor modifications were made based on their feedback.

The 19-item pre-intervention survey included three demographic questions (i.e. age range, gender, program year) and one clinical experience question. There was one question each about DH's current TD knowledge, use of TD, and TD governing policies, two questions about adoption of TD into the DH curriculum, and ten questions regarding how TD can improve access to oral health care. Further, there were two questions whether TD should be adopted into DH curriculum. In addition to the pre-survey questions, the post-intervention survey included two items addressing *how* TD should be implemented into curriculum, one question each regarding barriers to curriculum implementation, and expected utilization of TD upon entering DH practice after graduation for a total of 23 questions. The curriculum methodology and post-graduation practice questions were limited to the post-survey because it was felt students would not have enough knowledge of TD to provide a response in the pre-survey. All items used either yes/no/I don't know categories or Likert Scales. Likert scales were used to assess knowledge (1= no knowledge to 5= very knowledgeable), attitude (1= not at all to 5= a great deal), and curriculum (1= poor to 5= excellent). Additionally, the pre- and post-surveys included four coding items with one letter or number answers to create a personal identification known only to the participant, which were used by the researcher to do a matched paired analysis of pre-and post-intervention answers.

Implementation

Students were recruited through email and paper flyers advertising the TD program and participants were asked to sign-up prior to the presentation. The intervention took place in two separate sessions, one for first year and another for second year DH classes. Two hours were allotted for each session. The sessions began with obtaining informed consent followed by the administration of the voluntary digital survey to assess their self-reported knowledge and attitudes about TD prior to the intervention. The survey link and QR code were displayed via a projector for ease of access via smartphone or computer. All consenting participants watched a forty-minute pre-recorded presentation about TD, followed by a ten-minute question and answer session where the facilitator (CM) answered all questions asked by the students. Participants were divided into small groups of 3-6 students. Each small group, guided by the facilitator (CM), discussed the following questions for thirty minutes. *1) Do you think TD has or does not have the potential to help alleviate the oral health crisis in North Carolina? Why or why not? 2) What and how would you like to learn about TD while in school? 3.) Identify challenges and potential solutions to implement TD in DH curriculum.*

All participants reconvened as one group to share their answers to the same questions in an open forum debrief, guided by the facilitator, for thirty minutes. A non-participant student notetaker recorded the main discussion themes. At the conclusion of the session, participants completed the post intervention survey.

Data Analysis

All participants included in the analyses were matched for pre-post survey responses using unique identification characteristics. Data from the matched pair responses were used for statistical analyses. The demographic variables were tabulated and summarized. Categorical variables with 5 Likert-scale response options were dichotomized with categories 1-2 combined as "no" and 3-5 as "yes." "I don't know" responses were interpreted as having negative connotation and categorized as "no". Descriptive analyses were performed for each categorical variable and the distribution of these categories for the pre- and the post-intervention surveys were compared and reported. Due to the relatively small cell counts for each of the contingency tables, exact McNemar's matched pair test was used to compare the proportion of the participants' responses to the pre-post survey questions for each binary outcome. Sensitivity analyses were conducted to assess whether DH students' responses had any differences pre-to-post intervention. The standard 5% statistical significance level was used for all statistical tests. A software program (SAS version 9.4, SAS Institute Inc.; Cary, NC, USA) was used for the statistical analysis.

Results

Seventy DH students were invited to participate while thirty students attended the session and completed the pre-and-post intervention surveys for a participation rate of 43% (n=30). The analytic pre-post survey sample included 10 first year and 20 second year DH students. The majority (77%) of study participants were between the ages of 18-24 with 23% of

the sample aged 24-34 years. All of the participants (100%) identified as female, compared to 99% of the students enrolled in DH classes. Most (96%) held residency in NC.

Self-reported knowledge and attitudes

Participants' responses regarding TD and its impact on access to care in NC following the educational intervention are shown in Table I. The proportion responding "yes" increased in all categories except one, where it remained the same. Responses regarding TD facilitating consultations with health care specialists in NC increased significantly from pre-to-post intervention (p= 0.012). There was also a significance difference in favorable responses (p=0.039) to the concept that TD could increase reimbursement to dentists and enhance the provision of more services in NC.

Table I. Pre- and post-survey perspectives on potential advantages of teledentistry (n=30)

What issues do you think teledentistry can address in North Carolina?*	Pre- Survey "yes" n (%)	Post- Survey "yes" n (%)	*p*-value
Increase access to care	25 (83)	27 (90)	0.727
Increase efficient use of clinicians' time	21 (70)	23 (77)	0.508
Increase efficient use of patients' time	22 (73)	27 (90)	0.063
Reduce patients' travel costs	24 (80)	28 (93)	0.344
Increase patient outreach	24 (80)	26 (87)	0.508
Facilitate consultation with health care specialists	19 (63)	27 (90)	0.012**
Improve oral health in rural North Carolina	23 (77)	23 (77)	0.999
Increase reimbursement to dentists by provision of more services	14 (47)	21 (70)	0.039**
Increase the number of dentists who are prepared to treat patients in the rural/underserved communities in North Carolina	17 (57)	23(77)	0.109
Other, please specify	—	1 (3)	—

* Response options: yes/no/I don't know ** $p < 0.05$

Comparison of pre-and-post-survey responses showed a significant difference in self-reported knowledge of TD among students in the analytical sample (p<0.001) as shown in Table II. There were no significant pre-post differences (p=0.999) among students' attitudes regarding the DHs' role in the delivery of services through TD (Table II). Based on post-survey responses following the intervention nearly all participants "agreed" or "strongly agreed" (93%) that they gained knowledge that they could use in the future.

Participants were asked what barrier, among six choices, needed to be addressed first in order to adopt TD into practice. A majority of students (63%) reported that the state dental practice act requiring direct supervision of DHs in NC was the first barrier to address. The second barrier, cited by 30% of participants, was the lack of TD focused continuing education.

Teledentistry curriculum

Participants' attitudes regarding the inclusion of TD in DH curriculum were high both before and after the intervention. Prior to the intervention, 80% of students thought that there was a "good", "very good" or "excellent" value in including TD in curriculum while 87% felt strongly following the session (Table II). No significant attitude changes regarding adopting TD into the DH curriculum (p = 0.727) were identified, likely due to the high proportion already in favor of its inclusion pre-intervention. Nearly half of the participants concluded that TD could be taught in several ways: using simulated cases, in didactic courses and clinical practice (Figure 1). Over half of the student participants thought that TD experience could be integrated into DH extramural community rotations. The DH extramural rotations include students traveling to community settings (pre-schools, elementary/middle schools, nursing homes) to provide oral hygiene education and conducting screenings for oral disease among elementary school children. Barriers to the implementation of TD into the curriculum included cost of required technology, lack of perceived instructor technical skills, lack of student interest and restricted scope of practice for DHs. It is noteworthy that the analyses showed a slight, non-significant increase in self-reported desire to implement TD in NC (p=0.726) but 57% of the respondents indicated that they were unsure if they would practice using TD as a part of patient care delivery after graduation (Figure 2).

Discussion

This study identified the self-reported knowledge and attitudes toward TD among a DH student population at UNC ASoD, where TD was not part of the DH edu-

Table II. Response distribution for pre-and post- intervention for teledentistry knowledge, attitude and curriculum application (n=30)

Type	Survey Question	Likert Scale				
Knowledge	Please rate the extent of your current overall knowledge about teledentistry on a scale of 1 to 5.	1 No Knowledge	2	3	4	5 Very Knowledgeable
	Pre-Survey n (%)*	13 (43)	13 (43)	3 (10)	1 (3)	0 (0)
	Post-Survey n (%)	0 (0)	1 (3)	10 (33)	13 (43)	6 (20)
	Please rank the extent to which you agree to this statement: "I gained knowledge in this session that I can use in the future."	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
	Post-Survey n (%)**	0 (0)	0 (0)	2 (7)	10 (33)	18 (60)
Attitudes	On a scale of 1 to 5, please rank the extent to which teledentistry should be developed in NC.	1 Not at all	2	3	4	5 Great deal
	Pre-Survey n (%)	1 (3)	0 (0)	9 (30)	8 (27)	12 (40)
	Post-Survey n (%)*	0 (0)	1 (3)	10 (33)	3 (10)	16 (53)
	On a scale of 1 to 5, please rank the extent to which dental hygienists should have a role in the delivery of services through teledentistry in NC.	1 Not at all	2	3	4	5 Great deal
	Pre-Survey n (%)*	1 (3)	0 (0)	3 (10)	10 (33)	16 (53)
	Post-Survey n (%)	0 (0)	2 (7)	5 (17)	3 (10)	20 (66)
Curriculum	On a scale of 1 to 5 please rank the value of teaching teledentistry within the dental hygiene (DH) curriculum?	1 Poor	2 Fair	3 Good	4 Very good	5 Excellent
	Pre-Survey n (%)	5 (17)	1 (3)	2 (7)	9 (30)	13 (43)
	Post-Survey n (%)	3 (10)	1 (3)	5 (17)	5 (17)	16 (53)

* Sum does not add up to 100% due to rounding ** Item included in post-intervention survey only

Figure 1. Incorporation of teledentistry instruction in dental hygiene curriculum

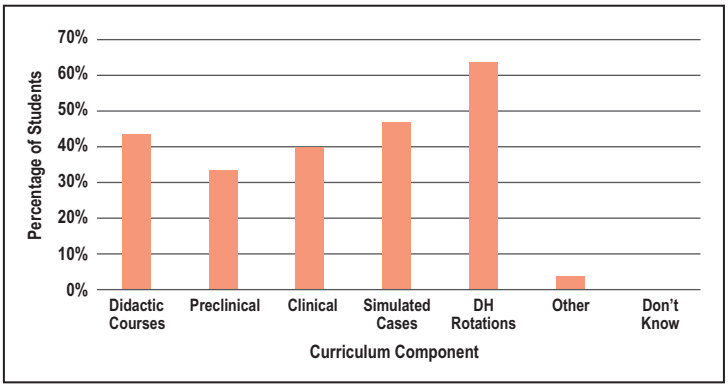
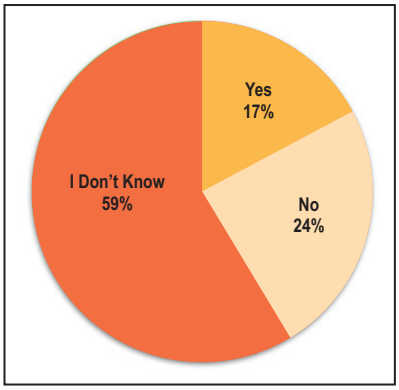


Figure 2. Participants' expectation of using teledentistry for patient care after graduation (n=30)



cation program and had limited adoption in the state. A key emphasis was placed on understanding students' perspectives on how TD should be adopted into their entry-level curriculum.

Knowledge

Though there are some studies that pertain to the inclusion of TD in DDS curriculum,[13,14] only a few advocate its inclusion in DH curriculum.[15,16] Learning about the multiple aspects and benefits of TD led to an increase in self-reported knowledge that students could use in the future. This knowledge gain through an educational intervention is supported by another study at the University of Nebraska Medical Center.[13] Third-and-fourth year dental students demonstrated knowledge gains regarding TD after completing didactic and hands-on TD training. Basic TD concepts including definition, technology, applications, scheduling, conducting consultations and record keeping were delivered through training modules.[13] These same TD concepts could be included in DH education programs.

Curriculum

Overall, participants in this study were in agreement regarding the value of including TD in the DH curriculum with DH students at Northern Arizona University (NAU).[16] On a scale of 1-5 (1 being poor and 5 being excellent), UNC students scored the value of TD in DH curriculum at an average of 4 (very good) while NAU students scored it at 4.3 (between very good and excellent). While minor, the difference in attitude between the two groups may be because DHs in Arizona have a less restrictive practice act and are able to utilize TD at a higher rate compared to NC.

Per current knowledge, this study was the first attempt to seek students' opinion on why and how TD should be taught in DH curriculum. A major theme from the debrief session was that TD should be taught through didactic lectures, followed by practice with hands-on training. However, the post-intervention survey revealed that a higher proportion of participants thought that TD was more appropriately taught through didactic coursework than through most types of hands-on training (i.e. preclinical and clinical practice, simulated cases). Perhaps this difference is due to the limited use of TD following licensure in NC because of the restrictive practice act.

Most participants felt TD could be used to enhance their community rotation experiences. Currently, DH students at UNC ASoD perform caries screenings elementary schools under the supervision of a public health DH. With TD, this experience could be enhanced by using technology to take intraoral photos of carious teeth for follow-up and referral to a dentist for treatment and could be modeled after the TD-assisted, affiliated practice model created at NAU.[16] This model allowed training of DH students to use TD equipment such as Nomad x-ray units, intraoral cameras, and electronic health records (for store-and-forwarding of data). Students then conducted screenings of pre-school aged children at multiple local Head Start centers and the data was sent to a contracted pediatric dentist for diagnosis and treatment planning. The project was supervised by NAU DH faculty and volunteer dentists were present. Additionally, the UNC survey found that students thought that TD could be implemented more easily in the school setting because of all the available technologies (i.e. electronic health records, computers, intraoral cameras, portable radiographic equipment, etc.).

Opportunities for dental professionals to use TD have expanded during the COVID-19 pandemic.[20] At the start of the pandemic, the American Dental Association recommended that dentists postpone elective treatment and perform only emergency and urgent dental care. As NC, among other states, began to open dental offices at limited capacity, dental consultation and triage delivered through virtual means to provide consultation and triage could help patients determine if their concerns constitute true dental emergencies or if they were less urgent.[21] This guidance helped prevent patients from seeking dental care at overwhelmed emergency departments and urgent care centers unless necessary.

With students in favor of incorporating TD into practice and curriculum, they can be afforded the opportunity to learn patient care skills with TD during the pandemic. Students could first be trained in how to use TD by virtual seminars with a TD expert, followed by practice with a simulated patient, then clinical patients. For example, the DH students could complete a synchronous video consultation with patients providing oral hygiene instructions, caries risk assessments, nutritional or smoking cessation counseling, while having a school faculty member virtually present. Students should also learn from TD initiatives, like the UNC ASoD virtual oral health care helpline, launched in March 2020. The helpline aimed to virtually address patients' dental concerns to prevent patients without true dental emergencies from seeking dental care at overwhelmed emergency departments and urgent care centers.[22] The exposure of oral health care professionals to TD during this pandemic will likely favor its continued use afterward. Because the pandemic environment has enabled increased provider experience with TD workflow and technology and an understanding of its ability to grant access to and improve quality of care, there will be a greater opportunity to incorporate TD into DH curriculum.

Access to Care

Generally, TD has been shown to increase access to care via consultations involving general and specialty dentists.[7,14,23] Additionally, in general health care, telehealth consultations have been shown to increase access to medical specialists.[24] The UNC results indicated that students think TD should be used to increase access to oral health care in NC and facilitate consultation with health care specialists. Furthermore, students concluded that access to preventive care (oral hygiene education, counseling, risk assessments, prophylaxes, and fluoride) could be expanded using TD. The majority of students also reported that TD could be used to increase efficient use of clinicians' and patients' time and reduce patients' travel costs. In other studies, TD has been successful in providing cost-savings for patients' travel expenses and provider equipment purchase, operation and time.[9,25] During the debriefing session, participants emphasized the value of TD-based care to augment traditional, in person care, not as a replacement.

Barriers to Implementation

The greatest barrier to implementing TD into curriculum identified by 93% of students was the NC state DH practice act requiring direct supervision of DHs. Less than one-fourth of DH students indicated that they expected to be able to use TD after graduation and licensure. The debriefing session revealed that this attitude may prevail until the NC practice act is changed to allow for widespread general supervision. Dental hygiene students do not see the value of learning a skill they cannot use upon entering practice. A study of key NC stakeholders by Weintraub et al. also concluded that the main barrier to TD implementation in NC is the direct supervision requirement.[19] Minnesota has created a supportive policy environment for DHs to practice under general supervision that has further allowed for TD integration into DH curriculum at Minnesota State University Mankato.[15,26] Additionally, the Virtual Dental Home utilizes DHs in a range of community settings, under general supervision, and has made a substantial impact regarding access to care in California.[8]

Lack of student interest was another frequently cited barrier to the implementation of TD into curriculum. During the debriefing session, students discussed the importance of educating other students and dental faculty about the benefits of TD in providing access to care to underserved populations. Faculty development programs are of great importance to ensure that all faculty have current understanding and use of TD technology. Students also felt that TD must show a clear return on investment to be an attractive DH curriculum addition.

Limitations

This study is limited by a relatively small convenience sample size from one program in NC. The study participants were more likely interested in learning about TD than non-participants, and these factors may impact the generalizability of the findings. Further study could be conducted among dental and dental hygiene students from other programs both within NC and out of state to understand their attitudes toward TD. Additionally, evaluation of knowledge and attitudes of faculty members in is needed. Subsequent provision of TD information and training to address gaps in knowledge would help to improve delivery of TD for dental education programs in NC.

Conclusion

The educational session resulted in increases of self-reported knowledge of TD and positive attitudes that TD implementation could help alleviate access to care issues. Findings also demonstrated positive attitudes toward the adoption of TD into multiple facets of DH curriculum. Education and hands-on TD training are valuable curriculum tools in the future practice of oral health care professional students. Easing the direct supervision requirement of for dental hygienists in NC could help support the incorporation of TD into common practice and the DH curriculum.

Acknowledgments

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2021 Dentsply Sirona/ADHA Graduate Student Research Abstracts

The following abstracts are from the participants of the Annual Dentsply Sirona/ADHA Graduate Student Clinician's Research Program. The purpose of the program, generously supported by Dentsply Sirona for the past 14 years, is to promote dental hygiene research at the graduate level. Dental hygiene post-graduate programs may nominate one student to participate and present their research at the Annual Conference of the American Dental

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Periodontitis Susceptibility in Patients with WHIM syndrome**

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**1st place award

Purpose: Studies in patients with single gene mutations reveal the role of specific genes and pathways in human health and disease. In this sense, studies in patients with genetic defects leading to periodontitis become important toward the understanding of genetic factors linked to periodontitis susceptibility. WHIM syndrome (Warts, Hypogammaglobulinemia, Infections, and Myelokathexis syndrome) is an autosomal dominant syndrome caused by gain of function (GOF) mutations in the chemokine receptor CXCR4. While severe periodontitis in early life has been reported in multiple cases of WHIM syndrome, a comprehensive characterization of periodontal clinical status has not been performed in a large WHIM cohort to date. Furthermore, mechanisms underlying periodontitis susceptibility in WHIM syndrome are not fully delineated. The purpose of this study was to characterize the extent of periodontal pathogenesis in patients with WHIM Syndrome immune dysfunction comparted to age-gender matched healthy controls through clinical parameters.

Methods: A cohort of WHIM patients (n=23) and age matched healthy volunteers (n=23) were clinically evaluated at the NIH hospital. Clinical parameters included probing depth, clinical attachment loss, bleeding upon probing, and missing teeth as well as radiographic evidence of bone loss.

Results: Patients with WHIM syndrome present with increased susceptibility to periodontitis. Thirty percent of WHIM patients presented with severe disease. WHIM patients had significantly increased mean probing depths $p<0.0001$, clinical attachment loss $p<0.0001$, percentage of sites bleeding on probing $p=0.0009$ and number of missing teeth $3.65+4.6$ compared to age/gender matched healthy volunteers $1.7+1.58$.

Conclusions: GOF mutations in CXCR4 lead to periodontitis susceptibility. Further studies are exploring mechanisms underlying this phenotype.

Predictors of Empathy Among Dental Hygiene Undergraduate Students**

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**2nd place award

Purpose: Empathetic engagement is thought by many medical and psychological researchers to be a vital ingredient in forming respect-based relationships between patient and clinician, ultimately leading to more optimal patient care. The purpose of this study was to examine the correlations between demographics such as age, year in school and type of institution on levels of empathy in entry-level dental hygiene students.

Methods: This cross-sectional observation study was conducted among dental hygiene undergraduate students attending The Ohio State University, Columbus State Community College, and Owens Community College. All 41 participants completed the 20-item Jefferson Scale of Physician Empathy®,

student version (JSE-S) along with demographic questions including age, gender, year in school, and the type of degree being sought—associate versus baccalaureate. Descriptive statistics were used to analyze the data. Group comparisons of the empathy scores were conducted using t-test and one-way analysis of variance ($p<0.05$). Regression statistics were conducted to see if the students' year in school and the type of degree being sought were predictors of empathy.

Results: Among the 41 participants, most scored between 83 and 89 for a total empathy score. Possible scores range between 20 (very low empathy) to 120 (very high empathy). The highest level of empathy was scored at 96; however, the mode was noted as 83. There was no statistically significant difference between levels of empathy of first- and second-year students, and those attending a two-year institution versus a four-year university. Age was not recognized as a predictor of empathy. Of the 41 participants, there were a total of 37 female participants, two male participants, and two who preferred not to disclose their gender identity. Gender was not considered as only 0.7% of the participants identified as male.

Conclusion: The present study does not show correlations or predictions of empathy within dental hygiene students' demographics. Future research should involve a less homogenous cohort and expand beyond a small convenience sample and include a longitudinal gauge to assess potential fluctuations in empathy as students progress throughout their clinical rotations.

Implementing Environmental Sustainability Educational Intervention in Dental Hygiene Education**

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****3rd place award**

Purpose: As the healthcare industry contributes to a large portion of national waste output, steps should be taken to minimize dentistry's contribution to waste and improve public health outcomes. The purpose of this study was to implement an educational intervention and assess its usefulness on improving dental hygiene (DH) students' perceptions and knowledge on environmentally sustainable dentistry (ESD).

Methods: A convenience sample of thirty-five second-year DH students at the University of North Carolina at Chapel Hill (UNC-CH) Adams School of Dentistry (ASoD) were recruited for this quasi-experimental non-randomized observational mixed-methods pilot study. The study intervention, an online educational module titled "Environmental Sustainability and Dentistry," was created and incorporated the 2nd year DH course "Clinical Dental Hygiene." Students filled out pre- and post-surveys immediately before and after completing the module. Surveys utilized Likert-scale and multiple-choice questions that ranged from self-reported level of knowledge & attitude on climate change and environmental sustainability to objective knowledge-based questions. Pre- and post-module survey scores were compared with paired t-tests. Three weeks after module completion, students were assigned a follow-up assignment and post-assignment survey to get feedback on the assignment. Univariate and qualitative analyses were conducted on the post-assignment component.

Results: Twenty-four students completed the pre- and post-module survey (Response Rate: 68.57%). Twenty-two participated in the post-assignment survey component (RR: 62.86%). There was a statistically significant ($p < 0.0001$) positive difference between pre-survey and post-survey ESD knowledge scores following the educational module intervention. There was also a statistically significant ($p < 0.0001$) positive difference between pre-survey and post-survey ESD attitude scores after module completion. Majority of responses (>90%) indicated that the follow-up assignment strengthened their ESD learning experience. Qualitative analysis revealed that the reflective assignment helped students apply module concepts in the real world and adopt behavioral changes to be less wasteful in clinic.

Conclusion: Findings from this study support instruc-tional interventions on ESD in DH education may improve student's knowledge of ESD and encourage behavioral changes to be more waste conscious.

The Need for Cannabis Education in Dental Hygiene Programs

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Purpose: Cannabis and the endocannabinoid system are rarely included in the education and training programs for health care providers. Patients are not aware of the risks associated with using cannabis and healthcare professionals should be well prepared to assess, educate, and treat patients who use cannabis. The purpose of the study was to assess the cannabis content within dental hygiene education programs.

Methods: An online survey was distributed to 327 dental hygiene program directors and respondents were asked to answer all 26 questions.

Results: With a 21% response rate and 100% completion rate, 60% of respondents responded cannabis content is provided within their dental hygiene program, 38% responded "no", and one responded, "I do not know". No significant difference existed whether cannabis is legal in the state for medical or recreational use and cannabis content either included or excluded from the dental hygiene curriculum.

Conclusion: The results indicated the need for cannabis to be included in dental hygiene education programs including didactic content and patient assessment. Further research is needed to identify standardized educational content and the endocannabinoid system for educators to instruct students. In addition to patient assessments, standardized recommendations to assist patients in alleviating adverse oral health effects is also important.

Relationship Between Original Research Experiences and Evidence-based Practice Among Undergraduate Dental Hygiene Students

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Purpose: Engaging undergraduate dental hygiene students in research experiences may foster interest and overcome barriers to graduate education and may improve the implementation of evidence-based practice. The purpose of this study was to explore the relationships between original research experiences and evidence-based practice among undergraduate dental hygiene students.

Methods: Upon IRB approval (TUI#1209), this study utilized a quantitative survey method. The target population included a non-probability sample of undergraduate dental hygiene students in the last year of their entry-level dental hygiene programs. The research spider instrument measured original research experience and the KACE instrument measured evidence-based knowledge, attitudes, access, and confidence in implementing evidence-based practice. Survey invitations and two e-mail reminders were sent to program directors of US dental hygiene programs to forward to dental hygiene students in their final year. The data were analyzed using descriptive statistics, bivariate analysis, and linear regression.

Results: Preliminary data was received from 128 respon-dents. The level of research experience was M=27.63 (SD=7.88) and the level of evidence-based practice was M=92.80 (SD=15.04). Research experience was significantly correlated with evidence-based attitudes, access, and confidence ($p<.01$). Research experience was found to be a significant predictor of evidence-based practice ($p<.001$).

Conclusion: The level of research experiences impacted the level of evidence-based practice among undergraduate dental hygiene students. Incorporating original research experiences into the dental hygiene curriculum may improve the implementation of evidence-based practice.

Oral Care for the Pregnant Patient: An educational intervention

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Purpose: Interprofessional collaboration can help prevent adverse pregnancy outcomes related to poor oral health. This study examined if an educational module provided by a dental hygienist (DH) could increase the knowledge and confidence of physician assistant (PA) students with preventive oral care for the pregnant patient.

Methods: A one-group mixed-method approach was utilized in this research study. Pregnancy and oral health knowledge were assessed using a 9-item pre-test and posttest survey. Participants completed the pretest, were presented an educational module, and were asked to complete an immediate post-test. A second post-test was sent via e-mail to the participants three weeks after the educational module concluded. Pre-test and first posttest answers were compared for statistical significance. The first posttest and second post-test were compared for participants' knowledge retention.

Results: A total of (N=54) first year PA students were included in this study. The mean posttest score was statistically significantly higher than the mean pre-test score ($p < 0.001$). The results from the pretest and first post-test demonstrated a statistically significant increase in knowledge and confidence. There was also a slight increase from 4.16 (SD= 0.51) to 4.22 (SD=0.47) in mean scores from the first post-test to the second post-test indicating knowledge retention.

Conclusion: A pregnancy and oral health care educational module is an effective method to increase knowledge and confidence for PA students. Interprofessional educational experiences and interprofessional collaboration may decrease oral health disparities for women of child-bearing age which could help reach the Healthy People 2030 goal for increasing access to dental care including preventative services.

Registered Dental Hygienists' Perceived Preparedness on Treating Patients with Special Health Care Needs

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Purpose: Current census data shows a growth in the special needs population and dental hygienists may not be adequately prepared to treat this population. The purpose of this study was to examine dental hygienists' perceived preparedness when treating the patients with special health care needs (SHCN) and how it relates to their dental hygiene (DH) education.

Methods: Paper surveys were mailed to a random sample of 1,036 licensed dental hygienists in Alabama, Florida, Tennessee and Texas.

Results: A total of 181 surveys were returned, for a response rate of 17.5%. Approximately 69% of respondents indicated that they felt their education only somewhat prepared them or did not prepare them to treat patients with SHCN. Respondents indicated that their clinical training on patients with SHCN was more beneficial than didactic course content in improving their confidence and comfort for working with this population. Results of this study also indicated a significant relationship (p=0.003) between the time spent on the subject of patients with SHCN during DH education and the participant's perception of how well their DH education prepared them.

Conclusion: Results suggest that dental hygienists agreed there should be more education on the patients with SHCN. Inclusion of a mandatory, annual continuing education course on the patients with SHCN may be beneficial for all dental hygienists. The addition of such a requirement may increase dental hygienist's comfort level and in turn, increase their willingness to treat patients with SHCN in their dental practice.

Associations Between Oral Health Literacy and Periodontal Health: A pilot study

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Purpose: Growing evidence associates low oral health literacy (OHL) with poor oral health outcomes. While nearly half of United States adults have periodontal disease (PD), conflicting results of the association between OHL and PD require research using the most current and appropriate research measures. The purpose of this pilot study was to identify the association between functional OHL and periodontal health as defined by the American Academy of Periodontology (AAP) classification system.

Methods: A cross-sectional study was conducted with dental patients presenting for dental hygiene care at a Midwestern Federally Qualified Health Center. Functional OHL was measured using the Oral Health Literacy Adults Questionnaire (OHL-AQ). Periodontal health was measured clinically and categorized by stage and grade. Additional demographic factors and health history information related to periodontal health were collected. Descriptive analysis reported the median and range for ordered variables, and frequency and percentages for categorical variables. Wilcoxon rank sum test, Kruskal-Wallis test, and Spearman correlation coefficients were used to find association between OHL and periodontal health.

Results: Statistically significant associations were found between OHL-AQ scores and AAP staging and grading categories. Smokers were associated with more advanced periodontal disease stages and grades. Periodontal disease stage increased with age, and periodontal disease grades progressed among diabetics. No associations were found between periodontal health and sex, race, ethnicity, education, insurance, or country of origin.

Conclusion: Functional oral health literacy had a significant inverse relationship with both AAP periodontal disease staging and grading. A larger study is needed to confirm the findings of this pilot study.

Prevalence and Predictors of Workplace Bullying Towards the Dental Hygienist

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Purpose: Research indicates there is a positive correlation between burnout, withdrawal, and absenteeism among healthcare workers who have experienced workplace bullying (WPB). The purpose of this study was to investigate the prevalence of WPB among dental hygienists, and identify predictor/catalysts to WPB.

Methods: Cross-sectional survey research was used with a convenience sample of dental hygienists (n=943) providing patient care to explore WPB. The survey was shared via social media on Facebook and Instagram group pages, specifically dental focused. The validated Negative Acts Questionnaire-Revised (NAQ-R) was used to measure exposure of WPB using descriptive, correlation, chi-square, and Mann-Whitney U.

Results: The completion rate was 81% (n=765). Results showed 21% of participants had experienced WPB now and then, 9.4% several times a week, and 2.9% almost daily. Predictors for WPB included highest degree earned (p=-0.03), US (United States) region of residence (p=0.001), clinical setting (private practice versus dental service organization) (p<0.001), clinical years of experience (p=0.002), and work status (full- or part-time) (p=0.02).

Conclusions: The findings confirm WPB has been experienced by 1 in 5 clinical dental hygienists. Workplace bullying is not a new phenomenon, but given the prevalence observed in dental hygiene participants, employers need to be active in preventing and managing bullying to create and maintain an effective dental team and positive work environment.

Attitudes of Virginia Dental Hygienists Toward Dental Therapists

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Purpose: The purpose of this study was to determine opinions and attitudes of Virginia dental hygienists toward dental therapists (DTs) and determine if current education level and years of practice affected opinions regarding education requirements for DTs.

Methods: After IRB approval, a 22-item questionnaire was distributed online to a convenience sample of 910 Virginia dental hygienists. Questions assessed attitudes toward DTs using a seven-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Further questions assessed demographics and open-ended responses regarding potential advantages and/or disadvantages of DTs. Independent samples t-tests and chi-square analyses were used to analyze results.

Results: A response rate of 22% was obtained (n=200). Most respondents agreed DTs were needed in Virginia (M=5.78, $p<0.001$) and supported DTs as a solution to access to care issues in Virginia (M=5.97, $p<0.001$). While most agreed it was important for Virginia to adopt dental therapy legislation (M=5.89, $p<0.001$), most disagreed DTs should be restricted to acknowledged underserved areas (M=3.19, $p<0.001$). No significant association was found between years of practice and opinions toward education requirements for DTs; however, a significant association was found between current education level and opinions toward education requirements for DTs (Fisher's Exact Test=34.17, df=9, p=.000, Cramer's V=.28).

Conclusion: Results revealed Virginia dental hygienists had positive attitudes toward DTs. A larger sample could provide more insight into opinions of the Virginia dental hygienist population.

Dental and Dental Hygiene Students' Practice Behavior in SBIRT (Screening, Brief Intervention and Referral to Treatment)

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Purpose: Substance misuses are challenging for the public health system and society in general. Oral health care providers can identify alcohol and substance misuse via SBIRT screening. The purpose of this study was to examine the alcohol and substance abuse screening practices of dental and dental hygiene students who had received SBIRT training.

Methods: A retrospective chart audit of patient records at a dental school clinic was performed to evaluate SBIRT practices. Data from SBIRT tools (Oregon Prescreen, AUDIT, DAST assessment) were collected between September 2017 to February 2020. Percentages of prompted and completed assessments and student type (dental vs. dental hygiene) were calculated. Chi-square or Fisher's Exact test were used to evaluate differences by student type.

Results: 451 records (51%) prompted a prescreen assessment, 123 (31.8%) an AUDIT assessment and 35 (9.0%) a DAST. Patient risk categories for the AUDIT: 83 (72.8%) low risk, 26 (22.8%) risky, 3 (2.6%) harmful, and 2 (1.8%) severe. Risk categories for the DAST: 13 (41.9%) low risk, 15 (48.4%) risky, 2 (6.5%) harmful, 1 (3.2%) severe. Completed prescreens by student type were 83% dental, 86% dental hygiene, 100% dental, 93% DH of AUDITS, 100% dental, 88% DH of DASTs. No significant differences were found between student type for completion rate.

Conclusion: Completion rates were high for students who received SBIRT training regardless of student type.

Assessing the Nurse Practitioners' Knowledge and Clinical Practice Regarding the Oral-systemic Link

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Purpose: Nurse practitioners (NPs) comprise a significant portion of the primary care workforce and play an essential role in patients' health awareness, prevention strategies, disease management, and provider referrals as needed. Nurse practitioners receive education on the oral-systemic connection; however, it is unknown whether the oral cavity is assessed as part of patient encounters. The purpose of this study was to explore the knowledge and practice habits of NPs in assessing the oral cavity and whether oral health care providers were utilized to deliver oral health education to NPs.

Methods: A survey was developed, pilot tested, and e-mailed to a convenience sample of 148 NPs in primary care facilities in West Tennessee. The survey was divided into the following domains: oral health educational background; oral-systemic knowledge and perceptions; confidence in knowledge and ability to evaluate the oral cavity; oral health assessment practices; oral health promotion practices; and oral care referrals. Data were analyzed using descriptive statistics.

Results: A total of 66 NPs participated in the study for a response rate of 45%. Respondents were primarily female (91%), aged 31 to 40 years (41%), with master's degrees (77%). Over half worked in primary care (56.1%) with the majority holding a primary care certification (81.8%). Most participants self-reported their oral-systemic knowledge as fair (58%), and less than one-third (30.3%) were confident in their knowledge and ability to evaluate oral abnormalities. Knowledge and confidence were significantly associated with assessing the oral cavity in new patients (p=0.002) and existing patient exams (p = 0.037). Fewer than 8% reported "almost always" regarding oral health promotion and over half (51.8%) reported being "almost always" comfortable making oral health referrals. None of the respondents reported having received any oral health education from dentists or dental hygienists.

Conclusion: Results indicate gaps in NP knowledge and confidence in oral health assessments. Education provided by oral health care providers could increase NPs knowledge and confidence in performing oral assessments as part of primary care and lead to early identification of oral-linked diseases and improved outcomes. Dental hygienists are well positioned to help fill in the gaps in the oral health education of nurse practitioners.

2021 Virtual Conference Poster Abstracts

The following posters were available for viewing during the American Dental Hygienists' Association Virtual Annual Conference held on June 28 -29, 2021.

Knowledge, Attitudes, and Perceptions of Dental Hygiene Students Regarding Medical-Dental Integration

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Purpose: Medical-dental integration provides a viable option for dental professionals to improve health outcomes, access to care, and lower overall health care costs to underserved populations, specifically children. The purpose of this study was to examine dental hygiene student knowledge, attitudes, and perceptions of an externship involving medical-dental integration during their senior year in the curriculum.

Methods: Second year dental hygiene students at a state university in the Midwest provided dental care to children consisting of screenings, radiographs, prophylaxis, sealants, fluoride varnish, and oral health education at the time of their well child visit at a community medical clinic. A ten item survey was administered to the participants before and after the completion of the six-month externship. A 5-point Likert scale was used to assess current knowledge of medical-dental integration, attitudes regarding its efficacy, and beliefs regarding making a difference in the overall health of children. Descriptive statistics and Wilcoxon signed-rank tests were used to analyze the data.

Results: A total of 19 dental hygiene students completed the survey (n=19). Post-survey agreement levels were significantly different from pre-survey levels in eight items ($p<0.002$). Participants reported higher beliefs that medical-dental integration can improve access to care ($p<0.001$), and increased knowledge of how to make a difference in access to care ($p<0.001$) following the externship and more students were in agreement that they want to make a difference in the issue of access to care ($p=0.002$).

Conclusion: Results from this pilot study indicate that dental hygiene students increased their knowledge regarding the benefits of medical-dental integration and were positively impacted by their experiences of providing dental care to children during well child visits. Beliefs that oral health impacts the total cost of medical care and overall health also increased. These findings support continued implementation of medical-dental integration externships in dental hygiene curricula.

The Profession of Dental Hygiene: Pathways to Career Choice and Influences on Professional Identity

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Purpose: The purpose of this study was to ascertain factors which influenced dental hygienists to choose the profession and identify ADHA resources which promote and sustain members' professional identity.

Methods: This was a quantitative, cross-sectional, non-experimental study. A 48-item web-based survey was designed and pilot tested. Multiple choice, Likert-scale, and open-ended questions regarding demographics (10), career choice (4), and professional identity (34) were used. The survey was disseminated by the American Dental Hygienists' Association to student and professional members. Descriptive and inferential statistics were used to analyze data.

Results: A total of 1,983 surveys (n=1,983) were returned, response rate of 6.3%. The majority (n=1,699, 86%) of respondents were professional members. Most participants were female (n=1,940, 98%), White (n=1,668, 84%), and 55+ years of age (n=727, 37%). Both student and professional members rated a desire to work in a health field as the most influential reason for entering the profession (n=59, 21% and n=468, 28%, respectively). Both groups identified continuing education and evidence-based research resources as positively affecting their professional identity (4.11.0 and

4.11.0, p=0.41, respectively) and (4.11.0 and 4.01.0, p=0.13, respectively). Advocacy efforts, Journal of Dental Hygiene, and Access Magazine had a significantly greater positive influence on Professional Members' professional identity (p=0.001, p=0.028, and p=0.001, respectively). Student members reported greater influence on their professional identity in the areas of patient care resources (p=0.01) and support of their career (p<0.001).

Conclusion: The desire to have a career in a health field was the most influential factor for career choice. Continuing education and evidence-based research resources most positively affects all members' professional identity.

US Virgin Islands' Caregiver Oral Health Knowledge and Feeding Practices of Children in Their Care

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Problem: Children with low socio-economic status have been identified as being at risk for early childhood caries. In the USVI, 32% of families live at or below the poverty level. However, the oral health knowledge and practices of USVI caregivers, and risk for early childhood caries in USVI children, has not been investigated since the 1990s.

Purpose: The objective of this study was to understand US Virgin Islands (USVI) caregivers' oral health knowledge regarding risk factors for developing early childhood caries, and the feeding practices of the children in their care.

Methods: A cross-sectional qualitative study was conducted with three focus groups, using semi-structured open-ended questions to collect data from participants (n=16). A non-probability purposive sampling technique was employed to recruit USVI caregivers (18 years of age and older) from a resource center that provides family assistance and resources for children aged 6 years and under. The ten (10) questions used to collect data centered on children's feeding habits and participants' knowledge of risk factors for dental caries. Participants' responses were audio recorded and transcribed using an online transcription software platform. Triangulation was employed in the thematic analysis with two investigators independently identifying emerging themes.

Results: Demographic data revealed the majority of participants were single (69%), female (87%), 20 to 30 years of age (44%), with a high school education or less (63%). The thematic analysis performed on the data identified three major themes; limited knowledge of etiology of dental caries, lack of understanding of influence of feeding practices on poor oral health, and lack of recognition regarding consequences of dental caries on well-being. Although participants expressed an understanding of the relationship between diet and dental caries, the majority (n=15/93%) reported that sodas and juices were the beverages most frequently given to their children. All of the participants (n=16/100%) identified snacks comprised of fermentable carbohydrates as the first choice served to their children.

Conclusion: Study results suggest caregivers from low socio-economic status backgrounds in the USVI should be educated on the risk factors for early childhood caries, and offered nutritional guidance on how to reduce the frequency of cariogenic foods and beverages for children in their care.

Tobacco Cessation Counseling Training for Medicaid Dental Providers

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Problem: There is a higher level of tobacco use among Medicaid beneficiaries than in the general population. The aim of this project was to reduce tobacco use among Medicaid beneficiaries by supporting dental professionals to initiate and promote tobacco cessation in their practices.

Purpose: The purpose of this program was to develop open access, continuing education-based Tobacco Cessation (TC) training modules for dental professionals. Through statewide promotion of the website resources, target dental providers who treat Ohio Medicaid beneficiary patients.

Key Features: The Ohio Department of Medicaid (MedTAPP) funded a two-year grant between The Ohio State University College of Dentistry and Case Western Reserve University

School of Dental Medicine to create and distribute online modules, patient scenario videos and resources on tobacco related harm and tobacco cessation methods. Contributors included professionals from dentistry, dental hygiene, public health, social work, medicine and pharmacy. A website was created to host fourteen 30-minute modules, patient scenario videos, literature references and resources for TC referrals. Module topics included foundational knowledge on tobacco harm, skills for behavioral modification, pharmacological treatment approaches and TC in special populations. To receive continuing education credits, participants register, view the module presentations and satisfactorily complete module tests. Live virtual continuing education webinars, highlighting a selection of the modules and videos, were also presented in the spring and summer of 2020, at no charge, to dental professionals and community health centers. The completed modules and website resources went live October, 2019 and are available at: https://www.ohpenup.com/tobacco-cessation.html. The project connected with Community Health Clinics and Federally Qualified Health Centers throughout Ohio. Additional partners included the Ohio Dental Association, the Ohio Dental Hygienists' Association, the Ohio Association of Community Health Centers and the Oral Health Improvement Through Outreach (OHIO) Project.

Evaluation Plan/Results: As of January, 2021, 301 individuals had registered on the website; 91 registrants completed continuing education modules, with an average of 7 modules viewed. Registrants represented 6 dental professional organizations and 12 educational institutions in Ohio, along with private practitioners. Among registrants, approximately 68% were dental hygienists, 20% dentists, 6% dental assistants and 6% others. Over 40% of registrants reported serving a population of greater than 30% Medicaid beneficiaries. A nearly equal number of participants received continuing education credits through attendance at the live virtual webinars. This project encouraged dental professionals to increase their knowledge of oral and systemic harm caused by tobacco use and to expand their skills in tobacco cessation methods.

Medical Emergency Management Training Utilizing High-fidelity Simulation: Faculty Confidence Levels and Perceptions

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Problem: Dental offices are seeing a growing number of geriatric and medically compromised patients in their practices that may increase the likelihood of medical emergencies. According to the Centers for Disease Control and Prevention (CDC), 80% of the older population have one chronic disease and 50% have two or more chronic diseases. Research has indicated a lack of confidence among dental professionals when dealing with medical emergencies.

Purpose: The purpose of this study was to determine faculty confidence in managing medical emergencies in the dental clinic utilizing high-fidelity simulation and assess their perceptions on utilizing this type of training within the dental hygiene curriculum.

Methods: This descriptive quantitative pilot study used a convenience sample of dental hygiene faculty observing student medical emergency simulation training at a small Midwest university. Prior to simulations, a pre-survey designed by the researchers was given to supervising faculty (n=11). This survey contained 12 statements regarding confidence when performing various medical emergency skills. A 5-point Likert scale was used to assess confidence. A post survey containing the same questions plus 5 additional questions regarding student engagement, learning, and future recommendations was distributed immediately following. Research data were analyzed using Wilcoxon signed-rank tests.

Results: For 11 of the 12 statements, an increase in confi-dence was reflected in the faculty's mean scores. A significant increase of confidence was identified for 1) administering emergency oxygen (p=0.038), 2) administering emergency medications (p=0.001), 3) obtaining accurate blood pressure readings (p=0.025), 4) initiating and implementing "Code Blue" emergency protocols (p=0.012), 5) managing a medical emergency (p=0.011), and 6) communicating with the patient during a medical emergency (p=0.026). All faculty stated the medical emergency simulation engaged the students, enhanced their learning, and would help them remember emergency procedures better. Furthermore, faculty recommended additional emergency simulation experiences and continued implementation of this type of training to teach future dental hygiene students.

Conclusion: High-fidelity simulation provides an opportunity for students to experience real-life medical emergencies without risk to patients. This type of training may be an effective tool to enhance learning and increase confidence in medical emergency management not only for the students but also for faculty in their own dental practice.

The Relationship Between Workload and Burnout in Dental Hygiene Program Directors

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Problem: Workplace burnout is a complex interplay of work stressors that cause physical, emotional, and mental exhaustion and is associated with job negativity, decreased work efficiency, and adverse health effects. The multiple demands of academic program administrators may place them at increased risk for burnout. The purpose of this study was to determine if prevalence of burnout among entry-level dental hygiene program directors was affected by workload.

Methods: A descriptive design was used to generate information regarding workload and the extent to which entry-level dental hygiene program directors in the United States experience workplace burnout. The Copenhagen Burnout Inventory (CBI) survey, a valid and realizable measure of burnout, was distributed electronically to a convenience sample of 325 dental hygiene program directors. Scored on a five-point Likert scale, the CBI measures overall, personal (6 questions), work-related (7 questions), and client/student-related (6 questions) burnout. Additionally, five demographic and three open-ended questions related to burnout were also included in the survey. Descriptive statistics and ANOVA were used to analyze data.

Results: The response rate was 39.1% (n=127). On the work-related burnout scale, more than half (52%, n=65) of participants indicated moderate to severe burnout. ANOVA revealed no statistically significant findings for overall CBI mean scores or any subscale based on administrative or research/scholarly activity workloads. However, ANOVA revealed statistically significant differences 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; $p=0.028$).

Conclusion: Results suggest workload impacts burnout. Program directors with higher teaching loads may have fewer administrative and research/scholarly activities contributing to lower work-related burnout levels. Regardless, one out of two dental hygiene program directors experience some type of burnout with the highest prevalence in the personal burnout subscale. Participants with the lowest workload allocations for administrative duties had higher overall burnout scores. More research is needed to identify stressors that cause burnout as well as mitigation strategies and education to alleviate burnout whether personal, work-related, and/or client/student related.

Knowledge of HPV among Dental Hygiene Students in Illinois

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Problem: Human papillomavirus (HPV) is becoming more prevalent among individuals and manifestations can be identified in the oral cavity at routine dental visits. HPV can go undiagnosed, although patients may have symptoms present in the oral cavity. A lack of understanding exists between HPV related lesions and other intraoral conditions. Furthermore, dental hygienists must feel confident in providing education on HPV.

Purpose: The purpose of this research is to assess the knowledge of HPV and confidence in providing patient education on HPV among associate and baccalaureate dental hygiene students in the state of Illinois. Differences between seniors and non-seniors were also examined.

Methods: This IRB approved, quantitative, cross-sectional study evaluated the students' knowledge and confidence in providing patient education on HPV. A 43-item electronic survey was developed to compile data collection that consisted of demographic and polar questions. The survey was emailed to eight program directors throughout the state to forward to their students (n=69, 26% response rate). A value of 1 was assigned for each correct answer on the composite knowledge score. The highest possible composite knowledge score was 41. Composite knowledge scores and confidence questions were

compared between senior students and non-seniors using an independent t-test and Mann-Whitney U test, respectively. The chi-square goodness of fit test was used to assess students' knowledge of oral manifestations of HPV. The study was approved by the SIUC's IRB (20230).

Results: The internal consistency (α) for the knowledge subscale and confidence subscale of the survey was 0.76 and 0.95, respectively, indicating adequate internal consistency for both sub-scales. There were no statistically significant differences between senior students and non-seniors for the composite knowledge scores or the confidence questions. The average confidence score for providing patient education was 3.28. Chi-square was statistically significant ($p<0.001$) for focal epithelial hyperplasia, oral squamous papilla, and condyloma acuminatum, indicating that students identified these intraoral manifestations less frequently than expected.

Conclusions: The results indicate more education regarding HPV is indicated through the dental hygiene curriculum based on the low knowledge score and low levels of confidence in providing patient education. Dental hygiene students did not feel confident discussing HPV with their patients but felt it was important to do so. Limitations included social desirability bias and small sample size.

Implementation of the Objective Structured Clinical Examination (OSCE) in the Assessment of in Dental Materials

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Problem: Workplace burnout is a complex interplay of work stressors that cause physical, emotional, and mental exhaustion and is associated with job negativity, decreased work efficiency, and adverse health effects. The multiple demands of academic program administrators may place them at increased risk for burnout.

Purpose: The purpose of this study was to determine if prevalence of burnout among entry-level dental hygiene program directors was affected by workload.

Key Features: The learning structure uses a "tell, show, do" approach. Students attend lecture followed by positive reinforcement with a demonstration and hands on laboratory experience. The student then collects material and verbalizes the procedure and rationale to the "mock" patient. During the procedure, the student orally presents each step describing the manipulation properly and delivery of the material. The student makes the commitment to the OSCE and challenged with questions directed with temperature change and setting times appropriate to the materials. Each OSCE is built on detailed rubrics describing a step-by-step process in the manipulation and delivery of material based on a case study. Expected outcomes include patient evaluation, rationale for material use, armamentarium, patient safety, manipulation, delivery and patient post-operative instructions.

Evaluation Plan: Four cohorts of students (2017-2020) participated in the investigation comparing outcomes in dental materials. The first group (n=90, 2017 and 2018) used a traditional practicum framework. The second group (n=91, 2019-2020) used the OSCE method. Evaluation of student performance of both groups was determined through identical quizzes, and exams. The OSCE group scores reflected consistently higher performance rates, whereas the scores for groups performing practicums revealed larger difference in student understanding. Those performing OSCE's scored higher, demonstrating a significant benefit to student learning with the implementation of the OSCE.

Dental Hygiene Faculty and Student Knowledge, Psychological Health and Vaccination Behaviors Regarding COVID-19: A pilot study

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Problem: The COVID-19 pandemic has been character-ized by extreme uncertainty, stress, and anxiety. Mitigating risk of contracting and transmitting COVID-19 while remaining current with the ever-changing information and guidelines has been challenging. Dental hygienists need accurate knowledge about COVID-19 in order to protect themselves and their patients. Lack of knowledge and psychological health may impact behaviors including vaccination.

Purpose: This pilot study aimed to gain insights on dental hygiene faculty and student COVID-19 knowledge, psychological health during the pandemic, and vaccination behaviors.

Methods: This descriptive quantitative pilot study used a 26-item online survey to examine the impact of COVID-19 on psychological health (10 items), decision to receive vaccination (2 items), and knowledge of COVID-19 (10 items). The validated Patient Health Questionnaire 4 (PHQ-

4) screened participants for depression and anxiety. Data collected between February 26 to March 1 were analyzed using descriptive statistical methods and t-tests.

Results: The 52 participants in this convenience sample were knowledgeable about COVID-19; the faculty mean knowledge score of 8.78 out of 10 was significantly higher than students at 7.79 (p=0.021). Of the ten items, 69.2% of participants did not know if the Food and Drug Administration had approved any drugs to treat COVID-19, and 42.3% did not know if ultraviolet light could be used to disinfect surfaces. The PHQ-4 identified 38.5% of participants with elevated anxiety scores and 21.2% with elevated depression scores. The mean PHQ-4 scores of students (2.57) were higher than faculty (0.89) at a significant level (p=0.023). Participants were significantly more anxious about contracting (p=0.037) and unknowingly transmitting (p=0.002) COVID-19 to others during normal daily activities than during clinical treatment. Of the students, 19 (46.3%) had received at least one dose of the vaccine, 13 (31.7%) intended to vaccinate in the future, and 9 (21.4%) did not plan to be vaccinated. One (11.1%) of the eight faculty did not plan to be vaccinated. Participants who did not plan to be vaccinated listed concerns about limited research regarding adverse effects.

Conclusion: In this pilot study, the majority of dental hygiene faculty and students were knowledgeable about COVID-19 and willing to be vaccinated, regardless of psychological health. It is essential for faculty to know the latest information and guidelines about COVID-19, and to educate students and patients. Further research with a larger sample is needed to determine if correlations exist between knowledge scores, vaccination behaviors, and/or psychological health.

Effectiveness of Adjunct Laser Therapy on Periodontal Pathogens: A systematic review

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Problem: Dental hygienists need to offer patients the most effective treatments possible within their scope of practice. In 2015, a systematic review and meta-analysis was published in the Journal of the American Dental Association indicating the use of photodynamic therapy with diode lasers as beneficial adjuncts to NSPT. However, the use of lasers within the dental hygiene scope of practice, including as an adjunct to non-surgical periodontal therapy (NSPT) continues to be a contentious subject.

Purpose: The objective of this systematic review was to evaluate if adjunct laser treatment was more effective than traditional NSPT alone in the reduction of periodontal pathogens.

Methods: To answer the question, "what is the efficacy of the adjunct use of dental lasers (including diode, NdYAG, ErYAG, and CO2) on microbiological parameters/indices," PubMed, Google Scholar, CINAHL, and Web of Science databases were searched for literature pertaining to the effects of laser therapy on periodontal microbes. The primary outcome was the reduction of periodontal pathogens. Inclusion criteria were randomized clinical trials, human studies, and published in English between January 2015 and December 2020. Keywords included "nonsurgical periodontal therapy", "periodontal disease", "laser therapy", and "pathogens." These terms were combined in various ways with "AND" and "OR" commands to obtain the most narrowly defined and relevant articles. A total of 1662 records were found, and after screening titles and abstracts, 187 articles were included. After full texts of the remaining studies were screened, another 174 publications were excluded. All screening was performed by three investigators. Thirteen, relevant full-text articles were read and evaluated independently. A meta-analysis was not performed because of the heterogeneity of the study designs.

Results: Overall, seven of the studies in this systematic review reported better treatment outcomes than SRP alone while six studies reported that the outcomes were comparable to SRP alone. All studies were assessed using a Cochrane review. Nine of the articles showed low risk of bias while four of the studies showed moderate risk of bias due to lack of information regarding some of the domains.

Conclusion: Within the limitations of the studies included in this systematic review, certain types of laser treatment in conjunction with NSPT are more effective at reducing the number of periodontal pathogens than SRP alone. The adjunct use of combined Nd:YAG + Er:YAG and diode lasers, including their use in photodynamic and low-level laser therapy, resulted in more improvement of microbiological parameters than SRP alone.

Integrating Case Management into the Dental Hygienist's Role: Improving Access to and Utilization of Oral Health Care for Pregnant Women

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Problem: In Maryland, Medicaid provides dental coverage for pregnant women yet only 28 percent of enrollees had a dental visit in 2018. Medicaid-enrolled pregnant women experience barriers to accessing dental care, which can negatively impact maternal and child health. This innovative program aims to decrease barriers to oral health care for an underserved community while providing experience for future dental hygienists in treating patients whose health outcomes are impacted by social determinants.

Purpose: In partnership with the University of Maryland Women's Health Center (UMWHC), the University of Maryland School of Dentistry's (UMSOD) Dental Hygiene program developed a case management protocol for low-income pregnant women to increase utilization of oral health care services. This program was designed to expand access to oral health care by integrating dental hygiene faculty and students into the prenatal healthcare protocol at a university-based women's health center.

Key Features: Key features of the program include (1) frequent dialogue between the UMWHC prenatal providers and the UMSOD to manage dental referrals and address patient concerns and 2) a streamlined, multistep process at the UMSOD to schedule, register, and coordinate oral health care that builds patient trust and addresses patients' dental needs. Information regarding prenatal oral health care safety, importance, and coverage by Medicaid, is disseminated to pregnant women through Zoom presentations during UMWHC "baby shower" events and case management services (via text or phone). These services are integral to increasing oral health equity for vulnerable pregnant women and expands the scope of dental hygiene practice.

Plan Evaluation: Data has been collected monthly by the program coordinator since program initiation in 2018, to evaluate effectiveness. Measures include: 1) number of pregnant women referred to the UMSOD from the UMWHC, 2) number of pregnant women who report for dental appointments at the UMSOD, 3) number of pregnant women who do not show for dental appointments at the UMSOD, and 4) number of pregnant women who complete comprehensive dental hygiene care. Current program data collected through case management of all UMWHC referrals indicates that partnering with the UMWHC and providing case management services has: 1) increased referrals from 5 to 30 per month, 2) increased the number of pregnant women who have dental appointments from 3 to 12 per month, 3) decreased the percentage of pregnant women who do not show for appointments from 75% to 31%, and 4) increased the percentage of pregnant women who completed dental hygiene care from 47% to 62%.

The Correlation between Periodontal Disease and Systemic Health in Rural Southern Illinois

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Problem: Patients who are treated in the dental practice often do not associate oral health with systemic health. Incomplete health history self-reporting confirms the lack of knowledge of current or existing health conditions. Periodontal disease can affect all individuals, although there is a higher prevalence among those living below the federal poverty level. In the southern Illinois region, approximately 1/3 of the population is covered under the medical assistance program.

Purpose: The purpose of this study was to identify the correlation between systemic health issues and periodontal disease and determine if consistencies exist with data from southern Illinois and national trends.

Methods: A convenience sample of current patients in the advanced periodontics clinic at Southern Illinois University Carbondale (SIUC) agreed to participate in this IRB approved study. An Excel data sheet was used to gather demographic information in addition to health issues and dental concerns from June 2019 to February 2020. Medical information included conditions that affect the nervous system, respiratory system, endocrine system, bone/muscle disorders, digestive system, urinary system, heart/blood vessel disorders and 'other' conditions. Patients received a periodontal screening to determine calculus deposit levels and the overall periodontal condition. Chi-square test of independence was calculated to test the relationship between systemic health issues and periodontal disease.

Results: High blood pressure was the most reported systemic health issue among all patients and among those ages 50 and older. Statistically significant relationships were found between periodontal disease and high blood pressure, joint

pain, and arthritis among all patients (n=927). No statistically significant relationships ($p<0.05$) were identified among those age 50 and older (n=348) however, not all patients completed all portions of the health history.

Conclusion: Oral-systemic relationships between perio-dontal disease, hypertension and joint conditions were identified from the data collected at the dental hygiene clinic at SIUC, an access point for patients who lack health care in the region. The dental hygiene clinic is the access point for patients who lack healthcare in the region. Future research should focus on educating this vulnerable population on oral-systemic health and overall risk reduction.

Impacts of Instrument Handle Design on Muscle Activity Production in Dental Hygienists

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Problem: Dental Hygienists are at an increased risk for developing musculoskeletal disorders due to the repetitive practice of instrumentation. Ergonomic instrument designs need to be identified to reduce muscle activity production and decrease the risk of musculoskeletal disorders in practitioners.

Purpose: The purpose of this study was to compare the effects of commercially available instrument handle designs on forearm muscle activity during scaling by dental hygienists in a simulated oral environment..

Methods: A convenience sample of 25 registered dental hygienists were recruited for this IRB-approved study. Ten commercially available instruments were categorized into four groups based on their weights and diameters: large diameter/lightweight, small diameter/lightweight, large diameter/heavy weight, and small diameter/heavy weight. Participants were randomized to four instruments with one from each group. Participants scaled with each instrument in a simulated oral environment while muscle activity was collected using surface electromyography. Muscle activity was compared among the four instrument group types.

Results: Muscle activity of the flexor digitorum superficialis was not significantly influenced by instrument weight ($p=.60$) or diameter ($p=.15$). Flexor policis longus muscle activity was not significantly influenced by instrument weight ($p=.81$); diameter had a significant effect ($p=.001$) with smaller diameter instruments producing more muscle activity. For the extensor digitorum communis and extensor carpi radialis brevis, instrument weight did not significantly affect muscle activity ($p=.64$, $p=.43$), while diameter narrowly failed to reach significance for both muscles ($p=.08$, $p=.08$); muscle activity for both muscles increased with smaller diameter instruments.

Conclusion: Results from this study indicate instrument diameter is more influential than weight on muscle activity production; small diameter instruments increased muscle activity generation when compared to large diameter instruments. Future research in real-world settings is needed to determine the clinical impact of these findings.