

Journal of Dental Hygiene

April 2021 • Volume 95 • Number 2

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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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Uniting through Diversity

Why has diversity become such a dirty word? Why does it trigger so many negative emotions? Is it because we have failed as a society to truly understand the fundamental principles of diversity? Have we allowed social media to formulate our thoughts and actions fashioning a limited view of the constructs of diversity? Perhaps society is experiencing diversity fatigue; mentally and emotionally exhausted from engaging in dialog about diversity, inclusion and equity initiatives.

This past year, we found ourselves thrust into a global pandemic. We experienced political discourse and social unrest. These matters have become the subject of many difficult conversations within our profession, our institutions, and our organizations, often leading to hurt relationships and other negative outcomes. These same issues are still front and center in 2021, with no end in sight. As members of the American Dental Hygienists' Association (ADHA), how do we move forward together? I would offer by embracing the concepts of diversity of thought, diversity of action, and diversity of culture.

It is impossible to address all facets of diversity in this limited space. Despite access to information, the cultural landscape of the world we live in is continually shifting requiring us to be fluid in our understanding of how cultural dynamics influence the context of diversity and necessitating the need for us to proceed bravely out of our comfort zone to gain a fresh perspective the dynamics of diversity.

The journey to truly understanding the premise of diversity begins with disassociating the word to simply mean race or an underrepresented population and expanding the meaning to encompass the dimensions of geographical regions, ethnicity,



physical abilities, religious beliefs, political beliefs, thoughts and actions. Essentially, understanding that diversity means being aware, accepting, and respecting the uniqueness in each individual. It also means recognizing and being sensitive to the experiences of historically underrepresented racial and ethnic groups without being condescending or disingenuous, since these experiences are very real for many individuals.

Working towards an improved understanding of diversity requires self-reflection and introspection, understanding your own history, experiences, and opinions and being aware and honest about your own personal biases and prejudices. It is important to recognize that we have all consciously and subconsciously created biases, stereotypes and prejudices. Because diversity is often associated with terms like discrimination, racism, and prejudice, people often think this type of self-awareness involves thinking of themselves as racist or prejudice. However, this type of honest self-awareness allows a person to gain insight on how their own perceptions shape their viewpoints and interactions with other people.

Being honest with yourself allows you to create space to accept and respect individuals for who they are. You must work to acknowledge that you have personal biases and prejudices in order to work to change them. Failure to acknowledge one's own internal biases will prevent you from getting anything out of your own personal journey towards understanding diversity. When you are able to recognize your own individual biases and prejudices you can begin to manipulate them to learn how to effectively engage with others and develop diverse listening tools to develop an understanding of diversity beyond your own perspective.

Diversity is paramount in our professional association because it is essential to the success of our work as a profession. It is not about simply checking off a box. In any professional organization, members are called to think and work together, not alike. Diversity goes beyond the affirmation of equalitysimply recognizing differences and responding to them. It means realizing the full potential of people, and in turn the organization, by acknowledging and appreciating the potential promise of each person's unique perspective and unique way of thinking. By acknowledging our individual ideas, perspectives and life experiences, we gain an enhanced capacity for problem-solving and creative thinking.

ADHA has made a commitment to diversity inclusion and equity (DEI). These critical concepts have been recognized within the ADHA strategic plan as a core value of the organization. That means that our work as an organization will move forward with the infusion of these core values. As the Diversity, Equality and Access Committee Chair, and an ADHA member, I, along with our committee members, now have the opportunity to help shape the tangible actions of ADHA so that all members and potential members see, hear and feel ADHA's commitment to DEI.

In the spirit of togetherness, I would like to share with you the African principle of Ubuntu, which means there is a universal bond of sharing that connects all humanity. In practice, Ubuntu means our commonalities are more important than any individual arguments and divisions within it. We should embrace this principle as we work together in supporting ADHA's mission and core ideology of uniting, empowering and supporting the dental hygiene profession.

In order to move forward, and get to a place of healing, we must push through diversity fatigue and realize there is power in recognizing and appreciating the uniqueness of all people.

Joy D. Void-Holmes, RDH, DHSc is the chair of the ADHA Inclusion, Diversity, Equity and Access Committee and past president of the Maryland Dental Hygienists' Association. Dr. Void-Holmes is the Dental Hygiene Program Director, Fortis College, Landover, MD and a member of the adjunct faculty at the American Denturist College, Eugene, OR.

Research

The Effects of the Traditional Scaling Technique Versus a Modified Scaling Technique on Muscle Activity and Pinch Force Generation: A pilot study

Jessica R. Suedbeck, MSDH, RDH; Cortney Armitano-Lago, PhD, LAT, ATC

Abstract

Purpose: Dental hygienists perform precision instrumentation tasks repetitively throughout the workday, placing them at increased risk for developing a musculoskeletal disorder. The purpose of this pilot study was to determine differences in muscle activity and pinch force generation between the traditional scaling technique and a modified scaling technique.

Methods: A convenience sample of dental hygienists (n=12) acted as their own controls in this counterbalance-designed pilot study. Muscle activity and pinch forces were assessed while participants performed traditional and modified scaling techniques with designated instruments on artificial calculus applied to the lower left quadrant of a typodont, for a period of five minutes. Surface electromyography was used to measure muscle activity; sensors attached to the instrument handle measured pinch forces. Participants were surveyed regarding the instruments used and scaling technique preferences at the conclusion of the session. Parametric and non-parametric tests were used to analyze the data. Descriptive statistics were used to analyze the exit survey.

Results: The modified scaling technique required less muscle activity than the traditional technique while scaling, however results were not significant (p>0.05). The traditional scaling technique required greater overall pinch force during scaling (p=.00). Pairwise comparisons revealed significant differences between pinch force generation in the thumb for the two scaling techniques (Z = -2.401, p= 0.016) and in the index finger (Z = -2.223, p= 0.026). The traditional scaling technique generated more pinch force (thumb x=7.25±4.99, index finger x=2.86±2.14) when compared to the modified scaling technique (thumb x=4.52±2.32, index finger x=1.65±1.28). Participants had a slightly higher preference for the instrument utilized for the modified scaling technique in terms of balance, maneuverability, overall comfort and the associated scaling technique as compared to the instrument utilized for the traditional scaling technique.

Conclusion: Use of a modified scaling technique may reduce muscle activity and pinch force generation as compared to the traditional lateral pressure scaling technique during instrumentation. Future research on ergonomic scaling techniques is needed to determine their efficacy and impact on musculoskeletal disorders.

Keywords: instrumentation, ergonomics, musculoskeletal disorders, modified scaling techniques, dental hygienists

This manuscript supports the NDHRA priority area, **Professional development: (Occupational health)** Determination and assessment of risks.

Submitted for publication: 3/30/20; accepted: 9/10/20

Introduction

Dental hygiene practitioners are at an increased risk for developing occupationally related musculoskeletal disorders (MSD).¹⁻⁶ The development of a MSD is multifactorial; workrelated MSDs among dental hygienists have been attributed to the physical stressors of dental hygiene practice including repetitive motions, poor ergonomics, prolonged static positions, and wrist/forearm positions outside of neutral for extended periods of time.¹⁻⁶ These MSDs involve tendons, ligaments, nerves, muscles, and blood vessels in the affected area and include disorders such as carpal tunnel syndrome (CTS), tendinitis, and stenosing tenosynovitis (commonly known as "trigger finger").⁷ Dental professionals have been identified as having high prevalence rates of occupationally-related MSDs resulting in lost time at work and increased medical care costs.⁷⁻¹² A systematic review conducted in 2009 determined the prevalence rates for MSDs in dental hygienists ranged from 60-96%, with the neck, shoulder, wrist, hand, and back all being negatively affected.¹³ Additionally, dental

hygienists have been identified as the dental professionals to be most often affected by MSDs, with higher prevalence rates when compared to dentists and dental assistants.¹³⁻¹⁶

Dental hygiene practitioners perform precision tasks repetitively and continuously throughout the workday on each individual patient. Periodontal instruments are used to remove plaque and calculus during scaling and root debridement procedures. Scaling requires dental professionals to manipulate instruments, using their fingers, wrist, and forearm to remove hard deposits from tooth surfaces. These repetitive, fine motor skills combined with the forceful and prolonged gripping of periodontal instruments are among the factors placing dental hygienists at risk of developing a MSD.^{6,17-21} The average pinch force produced during periodontal scaling and root debridement can range from 5% to 20% of the operator's maximum pinch force production.^{15,20} In addition to increased pinch force production, increased muscle activity of the forearm and hand have been identified during scaling and root debridement tasks.^{17,22-,24} Larger, more tenacious hard deposits require more muscle exertion for complete removal. Previous research studies have quantified the influence of scaling on MSDs through examining muscle activity of the hand, wrist, and forearm, as well as assessing the amount of pinch force produced to grip periodontal instruments.^{17,18,20,21,23,24} The greater the number of muscle activations and degree of pinch force a practitioner exerts throughout their career, has been shown to increase the likelihood of developing a related MSD.^{17,18,24}

In an effort to reduce the amount of pinch force and muscle activity experienced by clinicians during scaling, extensive research has been conducted in developing more ergonomic instruments.^{17,21,23,24} Accordingly, the resulting recommendations are to use lightweight, large diameter instruments with a round, tapered handle, designed to reduce the musculoskeletal workload for dental hygienists.^{17,21,23,24} While these studies have demonstrated several musculoskeletal implications of scaling, the assessment of scaling ergonomics has been limited to instrument design and have not examined the influence of scaling technique as a contributory factor to the development of MSDs.

Examining scaling technique is another step towards reducing MSDs and ultimately improving the overall quality of life and career longevity for dental hygiene practitioners. The traditional method for scaling is to utilize increased lateral pressure to remove hard deposits on the tooth structure. A modified scaling technique, utilizing reduced lateral pressure, has been proposed as a more ergonomic approach to periodontal scaling.^{25,26,27} There is a gap in the literature regarding the evaluation of scaling techniques

that may have an ergonomic impact on dental professionals, particularly dental hygienists. The purpose of this pilot study was to examine differences in muscle activity and pinch forces generated during traditional lateral pressure scaling techniques using a standard ergonomically designed instrument versus those generated with a modified scaling technique using a novel instrument designed for reduced lateral pressure. Operator preferences regarding the scaling techniques and instrument designs were also examined.

Methods

This study was approved by the Old Dominion University Institutional Review Board. Prior to data collection, initial pilot testing was conducted on two volunteer dental hygienists not included in the study sample, to evaluate and improve the research methods and test the software for synchronized surface electromyography and pinch force data collection during instrumentation utilizing both scaling techniques. Since this was a novel pilot study, the sample size was based on a power calculation (Effect size (Hedge's G)=1.95, α =0.05, 1- β =0.95) from a study that assessed the impact of experience levels of participants on pinch force generation during scaling.¹⁸ Mean pinch force measurements were used for this calculation (x=26.3±7.1, x=18.0±2.7). Power analysis showed that a minimum of 10 subjects were needed to achieve a 95% confidence interval and a 96% power.¹⁸

Participants were recruited through social media advertisements and were offered the two instruments used in the study as incentives to participate. Inclusion criteria included right-handed, healthy adults, with a current dental hygiene license. Exclusion criteria included any past or present injuries or disabilities of the working fingers, hand, wrist, forearm, shoulder, neck, and/or trunk. Additionally, any contraindications for electromyography equipment use (e.g., open wounds or burned tissue) were additional exclusion criteria. Individuals were eligible to participate after completing the preliminary recruitment screening questionnaire and after a visual inspection of the wrist and forearm for possible contraindications to equipment use. A convenience sample of dental hygienists (n=12) met the inclusion criteria and provided written informed consent to participate in the pilot study.

A counterbalanced design, with participants acting as their own controls, was used to reduce the likelihood of sequence effects. A simulated oral environment was created using typodonts attached to dental chairs. Artificial calculus (Kilgore International, Inc., Coldwater, MI) was applied with a template to all supragingival, mesio-buccal surfaces of the teeth in the lower left quadrant. The template ensured the same amount was applied exclusively to the mesio-buccal surfaces. Two typodonts were set up for each participant; with the scaling techniques and associated instruments randomly assigned to the typodonts to further ensure a reduction in sequence effects. Previous research has demonstrated how instrument weight and diameter may influence pinch force,¹⁷ therefore both instruments used in the study were Columbia 13/14 curets and weighed 10 grams and were 10 mm in diameter. For the traditional, lateral pressure technique typodont station, a stainless-steel instrument was used (Talon Tough[®], American Eagle Instruments[®], Inc., Missoula, MT). This instrument material is associated with the traditional, lateral pressure scaling technique taught in entry-level dental hygiene programs.

The modified scaling technique typodont station required the use of a different instrument design. The modified scaling technique utilized shaving strokes with minimal lateral pressure, a technique that is contraindicated with a traditional stainless-steel instrument as it would result in burnished calculus. Therefore, the modified scaling technique was performed with a titanium nitride-infused, stainlesssteel instrument (XP*, American Eagle Instruments, Inc., Missoula, MT).^{25,26} This is considered to be a stronger and sharper material, allowing for the modified scaling technique to be performed without the negative consequence of burnishing calculus.^{25,26}

Standardized instructions were given to each participant regarding the study procedures. To ensure all participants were familiar with the modified scaling technique, participants first completed a training video provided by the manufacturer with a slide presentation of training materials.^{26,27} The threeminute video explained the sharpen-free technology of the instrument and featured demonstrations of the modified scaling technique with various instruments.^{26,27} Following the training video, each participant was given the opportunity to ask questions of one of the investigators with experience educating on the modified scaling technique. Participants were allowed to practice the technique for fifteen minutes prior to data collection.

New universal curets (Columbia 13/14) for both scaling techniques were randomized for use. Participants were instructed to scale the mesiobuccal surfaces of the teeth in the lower left quadrant, using the randomly assigned scaling technique for a total of five minutes, regardless of the calculus level remaining on the surface. Exploratory strokes were not used in this study and it was not the aim of the study to determine calculus removal efficacy. Participants were instructed to use the sequence they were familiar with for scaling in this quadrant were allotted five minutes of rest between the two scaling techniques. Given the amount of time a calculus-removal stroke is utilized in clinical practice, this was considered a sufficient amount of rest to prevent fatigue.

Muscle activity of the forearm was collected using surface electromyography (sEMG) sampled at 1000 Hz, utilizing four lightweight, Noraxon sEMG sensors (2.8 grams; Noraxon, Scottsdale, AZ). The muscles of the forearm assessed were the flexor digitorum superficialis, flexor pollicus longus, extensor digitorum communis, and extensor carpi radialis brevis, per previous research.²⁴ These muscles control the fine motor skills requiring small flexion and extension adjustments at each of the fingers, thumb, and wrist. Surface electromyography is a valid and reliable instrument for muscle activity measurements and has been used in multiple studies examining the risk for MSDs in dental hygienists.^{17,21,23} One of the investigators, an athletic trainer, located each of the forearm muscles and placed the sEMG sensors on the corresponding muscles. Data were collected for a maximum voluntary muscle contraction (MVIC) of each muscle and were considered to be 100% of muscle activity the muscle could produce. The sEMG data collected during the five minutes of scaling with each instrument was expressed as an average percentage of the MVIC for that muscle,²⁴⁻²⁶ as participants used the same calculus-removal stroke for the entire duration. Background noise was also measured at both MVIC and data collection, thus eliminating this confounding variable.²⁸⁻³¹

Two pressure sensors (DTS Flexiforce Local Pressure Sensors, Noraxon^{*}, Scottsdale, AZ) were attached to the instrument handles to measure the amount of force used by both the index finger and thumb to grip the instrument while scaling. Participants demonstrated their normal grip location for scaling the mesiobuccal surfaces of the lower left quadrant and the sensors were placed on the instrument to measure the thumb and index finger pinch force based on the individual's grip. Correct placement of the sensors and sEMG were confirmed prior to data collection and the participants verbally verified that the equipment did not interfere with the scaling tasks.

Pressure sensors are valid and reliable instruments for measuring pinch force generated by gripping dental hygiene instruments and have been used in multiple dental studies.^{15,16,18,26} The sEMG and pressure sensors were tethered to the Noraxon[®] TeleMyo 2400T G2 transmitter, affixed around the participants waist, and all data was recorded using Noraxon[®] MyoResearch (XP) software (Noraxon[®], Scottsdale, AZ). An average pinch force generation was determined for each finger because participants used the same calculusremoval stroke for the duration of the five minutes of scaling. After completing both simulated scaling tasks, the participants completed an exit survey to assess perceived differences regarding balance, maneuverability, the scaling technique associated with the instrument and the overall comfort associated with the instrument. Responses were on a 6-point Likert scale, with 1 being not comfortable at all and 6 being very comfortable. Participants were also given the opportunity to make open-ended comments regarding their experience.

Prior to analysis, the assumptions for each of the parametric tests used were assessed. If the data were not normally distributed, outliers were removed from the data set, however if the assumptions were not met after this, non-parametric tests were used. For muscle activity 5 out of 104 datapoints were removed, for pinch force, 4 out of 52 data points were removed. For the comparison of muscle activity between the two scaling techniques, the sEMG data were analyzed using a two-way repeated measures ANOVA after outliers were removed. Additionally, if results were significant, a Sidak post hoc test was used to examine the specific difference between the two instruments and compare the amount of muscle activity of each muscle. A two-way Friedman ANOVA was utilized to analyze overall pinch force generated for each scaling technique. If results were significant, a Wilcoxon Signed Ranks test was used to compare the instruments to one another for each finger. Descriptive statistics were used for survey data. Data was analyzed using SPSS 24 software (IBM, Armonk, NY) with the significance level set to p < 0.05.

Results

All of the participants were female (n=12), 42% (n=5) were 18-29 years old, 33% (n=4) were 30-44 years old, and 25% (n=3)

were 45-59 years old. Three participants (25%) had never used the modified scaling technique before, six participants (50%) reported using the modified scaling technique with the sharpen-free instruments previously but had never being trained on the technique associated with the instrument, and three participants (25%) reported having the instruments previously and had been trained on the specific scaling technique. Participant demographics are shown in Table I.

The average muscle activity was compared between the traditional scaling technique and modified scaling technique using a two-way, repeated measures analysis of variance. The mean percentage of muscle activity compared to the MVIC (100% muscle activity) for each muscle used during instrumentation is shown in Table II.

Table I. Participant demographics (n=12)

Category	n (%)
Gender	
Female	12 (100)
Male	0 (0)
Age	
18-29	5 (42.0)
30-44	4 (33.0)
45-59	3 (25.0)
Ethnicity	
White	10 (83.3)
Native Hawaiian or Other Pacific Islander	1 (8.3)
Asian	1 (8.3)
Experience level	
Used sharpen-free technology before without training	6 (50.0)
Used sharpen-free technology before with training	3 (25.0)
Never used sharpen-free technology before	3 (25.0)

Overall, there was not a significant effect of scaling technique on muscle activity generation, F(3,21)=,461 p=0.713. The modified scaling technique generated lower muscle activity for each individual muscle when compared to the traditional scaling technique, although these results were not significant.

The average pinch force was compared between traditional and modified scaling techniques. The overall pinch grip was determined using the pressure data from both the thumb and index finger while using the instruments. The traditional

Muscle	Traditional Lateral Pressure Mean Percentage of MVIC (mV.) and standard deviation	Modified Shaving Mean Percentage of MVIC (mV.) and standard deviation	
Flexor digitorum superficialis	8.03±3.74	6.71±3.14	
Flexor pollicus longus	5.54±1.80	4.39±1.47	
Extensor digitorum communis	8.96±4.85	8.14±5.24	
Extensor carpi radialis brevis	6.71±2.85	5.71±2.44	
Overall mean	7.31±3.31	6.24±3.07	

Table II. Mean percentage of muscle activity compared to the maximum voluntary isometric contraction (MVIC;100% muscle activity)*

*Measured in millivolts (mV.) p's>0.05

scaling technique required a greater amount of pinch force for both fingers individually (Table III). A Friedman ANOVA was used to determine if there was a statistically significant difference for the mean overall pinch force generated between the traditional and modified scaling techniques. There was a statistically significant difference in mean pinch force generation depending on which scaling technique was used, $\chi^2(3)=25.36$, p=0.00. Post hoc analysis with Wilcoxon signed-rank tests was conducted and revealed significant differences between pinch force generation in the thumb for the two scaling techniques (Z=-2.401, p=0.016) and in the index finger (Z=-2.223, p=0.026), with the traditional scaling technique generating more pinch force (thumb x=7.25±4.99, index finger x=2.86±2.14) when compared to the modified scaling technique (thumb x=4.52±2.32, index finger x=1.65±1.28).

Finger	Traditional Lateral Pressure Mean Pinch Force (lbs.)	Modified Shaving Mean Pinch Force (lbs.)	<i>p</i> -values
Index Finger	2.86±2.14	1.65±1.28	.026*
Thumb	7.26±4.99	4.52±2.32	.016*
Overall Mean	5.06±3.57	3.09±1.8	.000*

Table III. Individual and overall mean pinch force generation

**p*<0.05

Participant preferences for the individual instruments utilized for the scaling techniques were examined with an exit survey to determine any perceived differences between the instruments. Both instruments were rated on a 6-point Likert scale, with 1 being not comfortable at all and 6 being very comfortable. Instruments were assessed on balance, maneuverability, scaling technique associated with the instrument, and overall comfort (Figure 1). The instrument utilized for the modified scaling technique (sharpen-free technology) averaged slightly higher in all areas when compared to the instrument utilized for the





*Likert scale: 1 being not comfortable at all and 6 being very comfortable

traditional scaling technique (stainlesssteel). Measures of central tendency and spread were computed to summarize the data from the end-user survey. The modified scaling technique instrument had a mean score of 5.50 ± 0.65 for balance, 5.67 ± 0.62 for maneuverability, 4.92 ± 1.38 for scaling technique, and 5.25 ± 0.92 for overall comfort. The traditional scaling technique instrument had a mean score of 5.33 ± 0.75 for balance, 5.42 ± 0.76 for maneuverability, 4.67 ± 1.93 for scaling technique, and 4.92 ± 1.04 for overall comfort.

Discussion

To date, the majority of studies examining the scaling instrumentation ergonomics for dental hygienists have focused on the instrument (e.g. handle characteristics), 6,17,18,24 while none have investigated the ergonomic differences in scaling techniques that are currently being introduced to clinicians.19,21 This pilot study explored the effects of a traditional lateral pressure scaling technique and a modified scaling technique on both average forearm muscle activity and average pinch force generation during scaling performed by dental hygienists. The repetitive nature of scaling has been strongly associated with the high prevalence of MSDs within the dental hygiene profession. The constant forceful gripping, or pinching, of instruments requires the repetitive use of fine motor skills at a prolonged force that result in high pinch forces.³¹⁻³⁴ Bramson et al. reported that on average, periodontal scaling requires 11-20% of maximal pinch force, an average 2.5 lbs,²² placing dental hygienists at an increased risk of developing work-related carpel tunnel syndrome.³⁵ The average pinch force found for the traditional scaling technique in the current study was 5.06lbs (±3.57lbs), considerably higher than findings reported by Bramson et al.²² However, these findings were more consistent with the pinch forces reported by Dong et al., where the average pinch force for a 10 mm curet ranged from roughly 6.5 lbs to 8 lbs (differing between instrument diameter and shapes). The methodological differences between studies could also

account for the differences in pinch force. For instance, the weight of the curets utilized in previous research range from 16 g to 24 g,^{24,33} while the weight of both instruments in the current study were only 10 g. When investigating methods of reducing pinch forces, the weight and diameter of the instruments can influence the amount of force used while scaling.^{17,24,32} The differences between the two studies further indicates that manual scaling can be modified through consideration of the weight of an instrument to reduce risk factors associated with the development of musculoskeletal disorders.¹⁷

To the best of the authors knowledge, this is the first study in the literature to investigate whether scaling techniques influence muscle activity and pinch force. One of the goals of the modified scaling technique is to minimize musculoskeletal strain on practitioners, including the overall amount of muscle activity or pinch force produced during scaling, and ultimately reduce the development of MSDs. Findings from this pilot study demonstrated that the average muscle activity was reduced when using the modified scaling technique versus the traditional scaling technique. The modified scaling technique requires minimal lateral pressure and utilizes a calculus-shaving stroke for the removal of deposits when compared to application of lateral pressure utilized in the traditional technique. This calculus shaving technique is recommended for use with a titanium nitride-infused, stainless steel instrument (e.g., a sharpenfree instrument) due to the qualities achieved through the manufacturing process.²⁵ This modified shaving technique is not recommended for use with a traditional stainless steel instrument because the material is not as strong, sharp, or wear resistant.²⁵ Findings from this pilot study suggest that modifications to the scaling technique reduced muscle activation during the scaling process and may over the long term, reduce the rate clinicians develop hand and wrist MSDs. Quantifying these claims of risk reduction in terms of muscle activity and pinch force are important, as ergonomics plays a key role in the long-term health and career longevity for dental hygienists. Instrument materials that allow for modified scaling techniques requiring less pressure, should continue to be explored for their ergonomic implications. Furthermore, the overall weight of the instrument may also provide ergonomic benefits in addition to the modified scaling technique.

An investigator created exit survey was used to assess the participants' perceived differences of the two instruments and the scaling techniques and to gain insight based on the participants' professional opinions. Both instruments used in this study were the same weight and diameter. Participants reported that both instruments were comfortable in terms of balance, maneuverability, scaling technique, and overall comfort; however, participants rated the instrument used for the modified scaling technique slightly higher in all categories. These subjective findings yielded ratings that trended consistently with the sEMG and pinch force measurements. The modified scaling technique produced less muscle activity and pinch force and could have contributed to perceived comfort, balance, and better maneuverability.

Participants also provided open-ended responses on both scaling techniques in the exit survey and expressed some concerns with regard to the modified scaling technique. Even though participants rated that sharpen-free technology instrument higher in all categories, several participants (n=5) indicated concerns for the modified scaling technique, stating a "shaving technique could result in burnished calculus" and "required a higher number of strokes for complete deposit removal" when compared to the traditional scaling technique. However, participants who reported prior training with instruments using the modified scaling technique did not share these same sentiments. It is likely the single training session, especially for the participants who had never used this technique previously (n=3), on the modified scaling technique, was not enough for the participants to feel confident in complete calculus removal using the modified technique.

While the results of the study highlight important ergonomic differences between a modified calculus shaving technique and the traditional, lateral pressure scaling technique, there were limitations that should be considered when interpreting these pilot study findings. One limitation was the amount of training time and experience with the modified scaling technique. Instrumentation education occurs throughout the dental hygiene education program for practitioners to achieve competency in the traditional lateral pressure scaling technique using traditional stainless-steel instruments. For some of the participants, the training video and brief practice time were the only opportunities to use the modified scaling technique prior to testing. Additional training sessions could have resulted in increased participant confidence in utilizing the modified scaling technique and for complete calculus removal. Further, the novelty of the modified scaling technique may have influenced the exit survey results. While the participants experienced in the modified technique did not share the same concerns expressed in the open-ended responses as the inexperienced participants, future research is needed to elucidate the implications of the modified scaling technique on overall effectiveness for calculus removal.

Additionally, this study used a simulated oral environment with scaling at a shorter duration than is typical for one day of work by a dental hygienist; muscle activity and pinch force could vary more over a longer time period and fatigue would become a factor that influences these results. Therefore, future studies in a real-world setting are suggested. Finally, the evaluation of calculus removal success was not an aim of the study, but this would also be important to examine in future studies. It would be important to know which scaling techniques are most successful for effective calculus removal and require less time with increased muscle activity and pinch force production.

Conclusion

This pilot study suggests that using a modified scaling technique may reduce muscle activity and pinch force generation during scaling and root debridement instrumentation performed by dental hygienists. The modified scaling technique should be further studied for its ergonomic benefits and evaluate whether the reductions in muscle activity and pinch force are enough to make a clinical difference for dental hygienists. The efficacy of calculus removal utilizing the modified scaling versus traditional scaling should also be evaluated in future studies. Longitudinal studies with additional training and a larger sample size are recommended to determine long-term outcomes of the modified scaling technique and other ergonomically considerate scaling techniques.

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Research

Investigation of the Cultural Competence of Dental Hygienists Practicing in a Region of Low Diversity

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Abstract

Purpose: The profession of dental hygiene is lacking in racial and ethnic diversity, a contributory factor to providing culturally competent patient care. The purpose of the study was to determine the cultural competence (CC) of licensed dental hygienists (DHs) in a region of low racial and ethnic diversity and explore the contributory factors.

Methods: A modified version of the Cultural Competency Assessment (CCA), a survey developed using the 3-D Model of Culturally Congruent Care was used to identify the levels of (CC) of DHs practicing in a area of low diversity. Utah was identified as a region of low racial and ethnic diversity. DHs holding a license to practice in the state of Utah were invited to participate in the 35-item, electronically delivered survey. Multiple regression was used to analyze associations between cultural competence and salient participant characteristics.

Results: Of the 3,231 RDHs invited to participate, 673 responses were included for analysis, for a 20% response rate. The mean score was 10.153 (SD=1.3), indicating moderate cultural competence, unequally distributed between cultural awareness and sensitivity and culturally competent behavior scores. Possessing a graduate degree, cultural education during dental hygiene school, cultural continuing education, and employment in public health, significantly predicted CC. The regression model was significant *F*(8,664)=8.616 (*p*<0.0005) with a small effect size (R^2 =0.094).

Conclusion: Education and types of practice experiences were predictors of CC. Specific educational interventions that may influence the various components of cultural competency were not determined. Dental hygiene providers possessed moderate CC however there was a disconnect in translating awareness into behavior, possibly reinforced by environments lacking racial and ethnic diversity with limited opportunities to develop and exercise CC.

Keywords: dental hygienists, cultural competence, health disparities, culturally competent health care, professional development, dental hygiene education

This manuscript supports the NDHRA priority area **Population level:** Access to care (vulnerable populations).

Submitted for publication: 4/4/20; accepted: 8/31/20

Introduction

Health disparities among racial and ethnic minority groups have been extensively recognized and documented.¹⁻⁴ The cultural competence (CC) of health care providers has been found to be a significant factor in racial and ethnic minority population health^{2,4-5} and has been identified as an essential component in the provision of culturally competent patient care.⁶ Health care provider CC contributes to improved patient provider understanding and trust, thus increasing patient adherence to provider recommendations and subsequently improving health outcomes.^{2,4-5}

When considering overall patient health, oral health plays a substantial role and is vital to patient wellness.⁷⁻⁹

Oral infections represent some of the most prevalent chronic conditions and are often more widespread in racial and ethnic minority populations.¹⁰ Among racial and ethnic minority populations, oral diseases may remain untreated and progress due to lack of access to care caused by fear and misunderstanding, cultural differences, socioeconomic disparities and geographical isolation.^{2-4,11} Dental hygienists are integral members of the oral health care team, providing both clinical, and educational patient services. As disease prevention and health promotion specialists, they are uniquely positioned to provide preventive oral care and health promotion services to underserved populations, including

racial and ethnic minority groups.¹² Therefore, in order to provide comprehensive, culturally competent patient care, it is critical that dental hygienists possess CC themselves.

Several factors have been identified that contribute to increased provider CC, including provider attitudes, patientprovider interactions, experiences with racially and ethnically diverse populations, organizational culture, educational programs, and the racial and ethnic diversity of providers themselves.¹³⁻¹⁷ However, limited conclusions have been drawn due to various research limitations and the multifaceted components involved.¹³⁻¹⁷ Considering that practitioner racial and ethnic diversity may be a possible contributing factor for provider CC, it should be noted that dental hygiene practitioners in the United States (US) exhibit limited racial and ethnic diversity,¹⁸ with approximately 85% identifying as white.¹⁸ In a profession with limited racial and ethnic diversity, in order to provide complete, culturally competent patient care, it is essential for providers to possess CC.

However, provider possession of CC is only one characteristic necessary for the provision of complete culturally competent care. Additional factors including organizational culture, patient perceptions and patient provider interactions, contribute to the provision of culturally competent care and lead to optimal patient outcomes.¹⁹ This multifaceted construct is demonstrated in the Three-Dimensional Puzzle Model of Culturally Congruent Care (3-D Model), which asserts that outcomes are highly interconnected. The 3-D model is a highly appropriate theoretical framework upon which to base research related to the relationships between provider cultural competence and patient outcomes.¹⁹⁻²⁰

The 3-D Model was developed from the Schim and Miller Cultural Competence Model (SMCCM). The Components of the SMCCM are cultural diversity, cultural awareness, cultural sensitivity, and culturally competent behaviors. In this model cultural competence is defined as the incorporation of experience, awareness and sensitivity (attitude) into behaviors.²⁰ The components of provider cultural competence, cultural diversity, awareness, sensitivity, and behavior as defined in the SMCCM have been likened to the pieces of a jigsaw puzzle as these components are interconnected. The 3-D Model builds on the first dimension of the four interconnected constructs proposed in the original SMCCM, those of cultural awareness, diversity, competence, and sensitivity. The 3-D Model then adds a second dimension of interpersonal relationships, relationships between providers and patients, as well as those between providers of different disciplines. The third dimension presented in the model is the desired result or outcome, to provide not just culturally competent but culturally congruent care.¹⁹⁻²⁰

Recently, the dimension of patient/provider relationship has been further expanded, resulting in the identification of the following four additional patient/provider relationship constructs: caring and trust, communication, social and spiritual support, and organizational environment.²¹

When considering the impact of provider CC on the provision of culturally congruent care, provider education may play an important role. However, while the majority of dental hygiene programs in the US report including cultural competency education within the dental hygiene curriculum, fewer than half report actually assessing students' ability to demonstrate the specific components of CC.²² Additionally, only the state of Connecticut requires continuing education in CC as a condition of dental hygiene licensure renewal, with a minimum of one contact hour every 2 years.²³⁻²⁴

Considering the importance of provider CC in the provision of optimum patient care and acknowledging current health disparities experienced by racial and ethnic minorities, there is a need for more information about the dental hygienist's role in the provision of culturally competent care. Currently there are no universal, post-graduation CC education requirements for licensure in the US and there is limited evidence of dental hygiene practitioner CC in addition to the limited practitioner racial and ethnic diversity within the profession. Dental hygienists practicing in regions of the US lacking in mandatory CC continuing education licensure requirements and located in areas of low racial and ethnic diversity, have fewer opportunities and no incentive to develop CC. This dental hygiene provider group may represent the lowest expected level of CC within the dental hygiene profession and provided an opportunity to conduct research into the CC levels dental hygiene practitioners and and the possible contributory factors. Utah is a Western state exhibiting extremely limited racial and ethnic diversity (approximately 88% White, 73% affiliated with a Christianbased faith)25 and also lacks any specific CC continuing education requirements for dental hygiene licensure.^{23,26} The purpose of the study was to determine the cultural competence of licensed DHs in a region of low racial and ethnic diversity and explore the relationships of possible contributory factors.

Methods

The study was reviewed and approved by A.T. Still University Institutional Review Board. A quantitative, crosssectional, correlational design was used with a modified version of the Cultural Competency Assessment (CCA) survey. The CCA was developed using the 3-D Model of Culturally Congruent Care¹⁹⁻²¹ and has been determined to be both a valid and reliable instrument to assess CC.²⁷⁻²⁸ Permission to use and modify the CCA was granted by the developers of the instrument.

The survey was administered online using REDCap^T, a secure web-based survey application, over a period of four weeks. A convenience sample of 3231 registered dental hygienists (RDHs) licensed in Utah was recruited using an email list obtained from the Department of Occupational and Professional Licensing (DOPL) and through personal contact at a regional state dental conference. Initial e-mails containing an invitation to participate in the study and a link to the external secure survey were sent, followed by two reminder emails to participants who had not responded, or who had only partially completed the survey. To encourage participation, an incentive for an opportunity to be included in a drawing for one of two \$50 Visa gift cards was offered.

The survey was comprised of 35 items including three qualifying questions, seven demographic items to establish sample population characteristics,¹¹ items to determine participant cultural sensitivity and awareness (CSA) and 14 items to determine participant culturally competent behaviors (CCB). To reduce survey length and enhance participation, questions pertaining to the Marlowe-Crowne Social Desirability Scale (MCSDS) were not included.²⁸ Participants achieved total CC scores (CCS) of 2-14 inclusive, composed of a CSA score of 1-7 and a CCB score of 1-7, with higher scores indicating higher CC. The participants' separate and summative scores were used to determine the separate and combined dimensions of CC for each participant. Surveys with incomplete responses were forfeited.

Data were exported to SPSS (IBM, Armonk, NY) and univariate analyses were conducted to describe the sample and determine the CSA, CCB and CCS of participants and total CCS by the level of degree obtained and the area of practice. Statistical assumption testing and regression analyses were conducted to determine the association of CC of the participant and the level of provider degree, the hours of CC education received as part of formal degree education, the hours of CC continuing education received since graduation, the amount of time elapsed in years since graduation, and the type of dental hygiene practice setting. The minimum required sample size to protect external validity and account for attrition was 120, determined using G*Power for a multiple regression with alpha level of 0.05, power of 0.80, and medium effect size ($f^2 = 0.15$).

Results

Data were inspected for missing responses and outliers, which were removed. In addition to incomplete surveys

and those with irrational outlying values, responses from participants who did not hold a current Utah license and those failing to agree to the informed consent were removed. Of the 3,231 RDHs invited to participate, 879 responses were recorded. After data cleaning, 673 responses were included for analysis, for a 20% response rate (n=673). Demographics are presented in Table I.

Table I.	Demographics	(n=673)
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Category	n	%
Sex		
Female	661	98.2
Male	12	1.8
Race		
White	628	93.3
Hispanic or Latino	15	2.2
Asian	6	0.9
Black/African American	3	0.4
Native Hawaiian or Other Pacific Islander	2	0.3
American Indian or Alaskan Native	1	0.1
Choose not to answer	18	2.7

Frequency and percentages of responses in each category are reported in Table II, along with the mean and standard deviation for the CC score of participants. The majority of participants were employed in a private office (85%), and held a bachelor's degree (65%). The mean number of hours of CC education or training during dental hygiene school was 20 (SD=25), while mean number of hours of professional development continuing education was 8.5 (SD=26.5). The data for both number of hours of dental hygiene schoolbased education and professional development continuing education are heavily right-skewed, with the majority of respondents (n=143) reporting no CC hours during school and over half (n=378) reporting no professional development CC education. This extreme skew of the data accounts for the high standard deviations observed. Respondents had been out of school for a mean of 12 years (SD=10.5).

The mean CCS for all respondents was 10.1 (SD=1.3), comprised of a mean CSA score of 5.9 (SD=0.4) and a mean CCB score of 4.2 (SD=1.1), indicating a moderate level of overall CC, unequally distributed between CSA and CCB. The highest mean CCS of 12 was exhibited by respondents holding doctoral degrees (SD=1.5) and those practicing in public health settings, with a mean of 10.9 (SD=1.5). The lowest CCS mean of 10.0 was found in respondents holding

			Cultural Competency Score	
	n	%	М	SD
All participants	673	100	10.1530	1.31291
Level of degree				
Associate	191	28.4	10.0403	1.23931
Bachelor's	436	64.8	10.1106	1.29104
Master's	42	6.2	10.9168	1.52134
Doctorate	4	.6	12.1331	1.03142
Area of practice				
Private office	571	84.8	10.0954	1.27362
Educator	39	5.8	10.7415	1.41171
Public health	23	3.4	10.9036	1.32675
Other	40	5.9	9.9695	1.51556
Researcher	0	0	0	0

Table II. Characteristics, and mean cultural competency scores for degree level and area of practice (n=673)

associate degrees (SD=1.2) and for respondents indicating "other," as the practice setting, with a mean of 9.9 (SD=1.5). Little difference in mean CCS was observed between respondents holding an associate degree or bachelor's degree or those reporting the private office as the area of practice. The lowest CCS mean of 9.9 (SD=1.3) was reported from respondents identifying "other" as their area of practice.

Multiple regression results were reviewed to determine how well the regression model fit the data and the output was analyzed for associations. The adjusted R^2 was .083, indicating a low level of explained variance (8.3%). The regression model was significant F(8,664) = 8.616, p < 0.0005. A summary of the multiple regression analyses is reported in Table III Possessing a graduate degree, hours of CC content during dental hygiene school, hours of continuing education, and working in public health significantly predicted CCS. There was no difference observed between the associate and bachelor's degree as predictors for CCS. Length of time since graduation did not significantly predict respondent CCS.

Discussion

The racial and ethnic diversity of providers has been demonstrated to contribute to increased CC; ideally the racial and ethnic diversity of providers should mirror the patient population served.^{4,13-14} Dental hygienists practicing in regions of low racial and ethnic diversity have fewer opportunities to interact with racially and ethnically diverse populations, thus have fewer experiences to develop, and subsequently practice

Table III. Summary of multiple regression analysis*

Variable	В	SE _B	β	Sig		
Intercept	9.7					
Education hours in school	0.009	0.002	0.175**	0.000*		
Continuing education hours	0.006	0.002	0.121**	0.002*		
Time since graduation	0.002	0.005	0.020	0.634		
Area of Practice						
Other	ref	ref	ref	ref		
Dental office	0.041	0.21	0.011	0.844		
Education	0.237	0.314	0.042	0.450		
Public health	0.689	0.336	0.095*	0.040*		
Education						
Associate's	ref	ref	ref	ref		
Bachelor's	0.037	0.111	0.013	0.740		
Graduate degree	0.749	0.249	0.144*	0.003*		

*B = unstandardized regression coefficient; SE_B = standard error of the coefficient; β =standardized coefficient. Sig=p **p<.05

CC. Utah is much less racially and ethnically diverse when compared to national demographics for dental hygienists.¹⁸ Additionally, there are no specific CC continuing education requirements for dental hygiene licensure.26 Therefore, it might be reasonable to assume that because the sample population exhibited comparatively low racial and ethnic diversity, and practiced in a state that lacked CC continuing education requirements for licensure, that the participants would have exhibited low CC; however, this was not the case. Results from this study are encouraging, with moderate levels of CC reported in contrast to limited research suggesting that the CC of dental hygiene practitioners may be lacking.²⁹⁻³¹ While the participants in this study exhibited moderate CC, possessing high cultural awareness and sensitivity, they did not report practicing culturally competent behaviors; which was consistent with previous findings.32 Both the amount of CC education during dental hygiene school and the number of professional development CC courses were determined to be predictors of provider CC, which was consistent with previous findings.³²⁻³³ An additional expected finding consistent with previous research was that holding a graduate degree was a predictor of provider CC.33

Working in a public health setting was also identified as a significant predictor of the respondent's CC. This finding may be explained by the fact that providers in the field of public health are more likely to have greater exposure to populations with higher racial and ethnic diversity and thus have a greater chance to interact with these diverse populations and, subsequently, more opportunities to develop CC.¹⁴⁻¹⁷ These results are encouraging considering the lack of racial and ethnic diversity of both the participants and the general population of Utah, as well as the lack of CC continuing education requirements in the state.²⁶ In order to increase the CC of dental hygiene practitioners, the professional association leadership could encourage members to participate in CC continuing education, such as the free online Cultural Competency Program for Oral Health Providers offered through the U.S. Department of Health and Human Services Office of Minority Health.³⁴

This study had limitations. Data collected via survey may be subject to social desirability bias and, as such, is subject to the honesty of respondents. Modification of the survey instrument involved removal of questions pertaining to the Marlowe-Crowne Social Desirability Scale to limit participant response burden.²⁸ Because the questions from the MCSDS, a measure of social desirability bias, were not included in the survey instrument, the effect of potential social desirability on participant responses was not determined.

Lack of racial and ethnic diversity among the participants, as compared to national statistics, may also have affected survey responses. Study participants were recruited solely from the dental hygiene profession; therefore, results are only generalizable to dental hygienists. Additionally, because participants were recruited from the state of Utah, the results may not be generalizable to dental hygienists practicing in other areas of the US or other countries. The lowest level of CC was recorded from participants who reported "other" as the area of practice. Since there was no opportunity for respondents to elaborate about their individual practice areas, it was not possible to determine how or why those providers scored at a lower level of CC.

Future research is recommended to repeat the study in a region of high racial and ethnic diversity, to determine whether the CC of dental hygienists is increased by exposure to a more diverse patient population. Alternatively, this study could be repeated to include the entire population of dental hygienists in the US and those practicing in other countries to determine the level of CC exhibited by dental hygienists practicing across the United States, as compared with dental hygienists practicing in other countries.

Continuing educational requirements for licensure vary across the US.^{23-24,26} The study could be repeated in the state of Connecticut which has a specific CC continuing education requirement,²⁴ to determine whether requiring continuing

education in CC has an effect on the cultural competency of providers and to what extent. Additionally, the effect of specific educational strategies to increase provider CC is undetermined;³²⁻³³ thus, future studies should determine the differential effects of specific educational interventions on provider CC. The need for increased racial and ethnic diversity in dentistry and dental hygiene was recently recognized by the American Dental Education Association (ADEA).³⁵⁻³⁶ Repeating this study with different health care professionals from different fields of differing racial and ethnic diversity, may be useful to determine the impact of the racial and ethnic diversity of providers on the CC of the profession.

Conclusion

Possessing and applying CC enables dental hygiene practitioners to provide optimal care to racially and ethnically diverse populations as integral members of the oral health care team. Respondents exhibited high cultural awareness and sensitivity but lacked culturally competent behavior, resulting in moderate overall CC. Holding a graduate degree, continuing education, and type of practice setting were predictors of CC. A disconnect in translating cultural sensitivity and awareness into culturally competent behaviors was identified. Dental hygiene students and practitioners need exposure to racial and ethnic diversity to provide culturally competent patient care. Steps should be taken to further explore the disconnect between cultural awareness and the implementation of culturally competent behaviors, standardize CC education requirements and address the need for a more racially and ethnically diverse oral health care providers.

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Research

Impact of Oral Health Education on the Knowledge, Behaviors, Attitudes, and Self-Efficacy of Caregivers for Individuals with Intellectual and Developmental Disabilities

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Abstract

Purpose: Individuals with intellectual and developmental disabilities (IDD) have a higher risk of oral disease and require assistance in performing oral self-care. The purpose of this study was to measure the impact of an oral health education program in improving caregivers' oral health knowledge, attitudes, behavior, and self-efficacy in providing oral health care to clients with IDD, residing in intermediate care facilities.

Methods: A non-probability sample of new hire caregivers (n=47) for clients with IDD residing in an intermediate care facility was used for this quasi-experimental study. A one-group repeated measures design was used to explore the effectiveness of an oral health education program. All variables were examined using summary statistics and evaluated for normality and statistical assumptions.

Results: Forty-seven participants attended the oral health education program intervention and completed the pre- and postintervention questionnaire. Seventy percent (n=33) completed the four-week post-questionnaire. A statistically significant (p=0.004) improvement in knowledge between the baseline questionnaire and four-week questionnaire was identified. Findings demonstrated slight increases in knowledge for caregivers with <1 year experience, and in those with previous medical training. No significant differences were found in behaviors or attitudes from baseline to the four-week follow up, however, there was a trend toward positive behavior changes.

Conclusion: Increased knowledge alone is not adequate to bring about and maintain positive oral health behavior change. Longer-term caregiver interventions, in addition to on-site support for oral care, are warranted to evaluate outcomes for individuals with IDD with the goal of reducing the burden of oral disease.

Key words: caregivers, oral health, oral health education, developmental disabilities, intellectual disabilities, intermediate care facility, oral care

This manuscript supports the NDHRA priority area, **Population level: Access to care** (interventions).

Submitted for publication: 1/13/20; accepted: 8/15/20

Introduction

Sixty-one million adults (25.7%) in the United States (US) are defined as having a disability under the Americans with Disabilities Act.^{1,2} Developmental disabilities (DD) are defined as mental or physical impairments that limit or prevent normal development, whereas intellectual disabilities (ID) limit intellectual functioning and adaptive behavior that may impair routine social skills and activities of daily living.^{2, 3} In young adults, cognitive disabilities are the most prevalent disability.¹ Examples of cognitive disabilities include autism, mental retardation, anoxic brain damage, stroke, and

post-traumatic injury resulting in learning disabilities.^{2, 3} The prevalence of developmental disabilities in children in the US (2009-2017) between the ages of 3 to 17 years, was shown to be one out of six children, an increase over previous years.³

Intellectual and developmental disabilities (IDD) are disorders that negatively impact the individual's physical, intellectual, and emotional development.⁴ These disabilities can occur *in utero* in all racial, ethnic, and socioeconomic groups; they may also occur after birth due to injury, infection, or be due to other environmental factors.^{2.5} Intellectual and

developmental disabilities affect multiple body systems and can impair a person's ability to learn, reason, problem solve, and perform social and life skills.⁵

Individuals with IDD have a higher risk of oral disease due to their limited understanding of oral health, their inability to perform physical tasks independently, sensory impairment, dysphagia, and poor access to dental care.4,6 A systematic review of 27 studies that included individuals with ID from 12 countries in a variety of living situations, including community dwelling and institutions, identified poorer oral hygiene, higher prevalence and severity of periodontal disease, and higher levels of untreated caries.⁷ Petrovic et al. found individuals with IDD had 1.6 times greater odds of experiencing dental caries than the general population, and those living in institutions had 2.4 greater odds of having untreated caries.8 Morgan et al. found that almost 90% of the individuals with IDD had some degree of periodontal disease, and the average numbers of decayed, missing, and filled teeth (DMFT) was 13.9 compared to the general population average of 7.7 DMFT.⁶

In addition to the previously noted factors affecting oral health, individuals with IDD frequently have complex oral health needs related to congenital and developmental anomalies that may be further compromised by behavior patterns and communication issues.^{7,9} Treating individuals with ID demands more time, patience, oral health knowledge, home care education, and greater overall caregiver skills than patients without an ID.⁹ Previous research suggests uncooperative behavior during oral care activities, combined with a caregivers' lack of oral health knowledge, are the largest obstacles in providing daily oral homecare to individuals with IDD.^{4,9}

In addition to a lack of fundamental oral health knowledge and inadequate training, caregivers also report additional barriers to providing oral hygiene care to individuals with IDD including lack of time and uncooperative clients.^{10,11} Research has also suggested that caregivers' comfort in providing oral home care to individuals with IDD was linked to training experience, job experience, and length of time working with individuals with IDD.¹¹

A study by Gonzalez et al. found that an educational program was more effective than exclusively discussing oral care procedures with caregivers of individuals with IDD, and that hands-on training, combined with a lecture, had an even larger impact on increasing caregiver oral care knowledge.¹² Research by Binkley et al. evaluated the outcomes of caregiver oral health training and found increases in caregiver supervision of residents (77% to 94%), dental flossing behaviors (66%), and praise used to support compliance (63%).¹³ The increase

in the level of caregiver supervision, use of dental aids, calm atmosphere, and monitoring of residents' oral hygiene care were all positive changes as a result of the oral health program implemented in eleven group homes.¹³

Despite these positive outcomes, research has been inconsistent and further study is warranted regarding oral health outcomes resulting from oral health education and training provided to caregivers working in intermediate care facilities (ICF) and group homes.^{4,13} Research has indicated a need to further investigate the most effective methods to increase oral health knowledge of caregivers that will lead to behavior changes in oral care activities and ultimately reduce the burden of oral disease in the individuals they care for with IDD.¹¹ The purpose of this study was to measure the impact of an oral health education program on caregivers' oral health knowledge, attitudes, behavior, and self-efficacy in providing oral healthcare to clients with IDD living in an intermediate care facility.

Methods

The MCPHS University Institutional Review Board (IRB) gave this study exempt status, protocol number IRB072018B.

This quasi-experimental, one-group repeated measures design used a non-probability sample to assess the outcome of an oral health education program for caregivers. Participants completed a baseline questionnaire prior to the program, a postquestionnaire immediately after the program, and a four-week follow-up questionnaire to measure retention and changes in oral health knowledge, behaviors, attitudes, and self-efficacy.

Sample selection

The study setting was Southern Wisconsin Center, a stateoperated intermediate care facility for individuals with IDD, in Union Grove, WI. The Southern Wisconsin Center (SWC) opened in 1919 and is one of three sites managed by the Department of Health and Treatment Services for individuals with IDD offering a wide range of programs and care to their clients.¹⁴ Southern Wisconsin Center provides their caretakers with training on activities of daily living care for their clients; however, the training does not include a oral health component. The non-probability sample consisted of caregivers newly hired through SWC (n=47). Caregivers were invited to participate in the oral health program during the SWC new hire training sessions. Inclusion criteria were SWC new hires who were 18 years of age and older, who spoke English. No specific previous oral health training was required for participation. A power analysis for this study recommended a minimum of 40 and a maximum of 60 participants.

Survey instrument

The questionnaire contained demographics (8 items) and 25 oral health-related questions regarding the following four subscales: knowledge (10 items), attitudes (6 items), reported behavior (4 items), and self-efficacy (5 items). The validated and reliable instrument (α =0.60) was created by Mac Giolla Phadraig et al.¹⁵ The only modification to the original instrument was one additional question in the attitude section (item 20).

Oral health education program.

The oral health program was based on "Train the Trainer, An Oral Health Training Toolkit" and permission was granted by Mac Giolla Phadraig et al. for use in this study.¹⁵ The program trainer was a registered dental hygienist with 13 years of working experience and the principal investigator (PI) for the study. The education program was two hours in length and consisted of an overview of oral health care, prevention of oral disease, causes of poor oral health, consequences of oral disease, oral-systemic links, adapting a toothbrush for special needs use, and patient positioning for brushing. The face-to-face delivery was through lecture, slides and live demonstrations. Participants were broken into small groups for demonstrations of brushing, flossing, and use of other oral hygiene aids on tooth models. The final component consisted of role playing with a partner. Participants demonstrated the brushing and flossing procedures on their partner and practiced adapting the toothbrush or patient positioning as needed while being observed by the PI. The program concluded with a question-and-answer session.

Procedure

Caregivers were invited to participate in the oral health training program as part of the training session for new hires. An email introducing the program and PI was sent by the SWC director prior to the start of the new hire training. Prior to the start of the oral health program, participants were provided with an informed consent form. The baseline questionnaire (T0) and demographic questions were completed prior to the attending the oral health education program using a webbased survey software program (SurveyMonkey[®], San Mateo, CA). A post-questionnaire (T1) was distributed to measure the impact of the education session on four domains of oral health directly following the completion of the program. A follow-up questionnaire was distributed four weeks (T2) after completion of the program to assess retention and changes in behavior practices.

Statistical analysis

Statistical analysis was carried out with SPSS^{*} version 23 (IBM, Armonk, NY). All variables were examined using summary statistics and evaluated for normality and statistical assumptions. For each subscale, the responses to items in that subscale were averaged to create a subscale value for each participant's response.

Correlations were performed using the distribution appropriate test to determine relationships between all variables. Repeated measures one-way ANOVA was used to determine if knowledge improved after the intervention. Matched-pairs t-tests were used to identify statistically significant mean differences between each data collection time point. The independent Mann-Whitney U was employed to test the difference in knowledge scores between different demographic groups. The Friedman K-sample test was used to determine whether attitude improved after the intervention. The Mann-Whitney U was calculated to test statistically significant differences in median attitude scores between demographic categories. The Friedman and Mann-Whitney U were also used to test whether positive behaviors increased after the intervention. A Bonferroni adjustment for Type II error was used for all matched pairs t-tests. For all inferential statistics, the alpha level, 95% Confidence Interval, and all relevant effect size data were calculated and reported.

Results

A total of 47 participants participated in the intervention and completed the pre- and post-intervention questionnaire (n=47). Seventy percent (n=33) of the sample completed the four-week follow up questionnaire. The sample included 38 females (81%) with a mean age 31.7 years and 4.7 years of experience. Sample demographic data are shown in Table I.

Knowledge

The average number of correctly answered questions for each time point are shown in Table II. To test the effect of training on knowledge, a one-way repeated measures ANOVA was conducted to compare the percentage of correctly answered items (DV) across time for each participant. There was a significant effect of time, Wilks' Lambda=.69, F (2, 25)=5.58, p=0.01. Three paired samples t-tests were used to make post hoc comparisons between conditions. Results indicated there was not a difference between the mean number of correctly answered questions (p=0.054) between pre-(M=7.5, SD=1.6) and post- (M=8.1, SD=1.2) intervention questionnaires. However, there was an improvement between pre-intervention and four-week follow up questionnaires

Table I. Demographics (n=47)

Category	Mean	SD*				
Age	31.7	10.8				
Experience, years	4.7	7.1				
Hours worked, weekly	38.6	4.5				
	n	%				
Gender						
Male	9	19.1				
Female	38	80.9				
Education	` 					
High school	12	25.5				
Some college no degree	19	40.4				
Associate or bachelor	14	29.8				
Master or doctorate	2	4.3				
Training Type						
During training	9	19.1				
CBRF	9	19.1				
RN	4	8.5				
CNA	22	46.8				
Missing	3	6.4				
Previous oral care training	Previous oral care training					
Yes	15	31.9				
No	32	68.1				

*SD=standard deviation of the mean

Table II. Measures of central tendency for dependent variables* (n=47)

	Pre (SD)	Post (SD)	Four Weeks** (SD)
Knowledge	7.5(1.6)	8.1(1.1)	8.9(1.1)
Behavior	3.0(1.0)	4.0(1.0)	3.0(.81)
Attitude	8.0(1.3)	7.0(1.2)	7.0(1.2)

*Knowledge scale was normally distributed and the mean plus SD=standard deviation reported. Attitude and behavior were skewed thus the median is reported.

** n=33

(M=8.9, SD=1.1, p=0.004). There was also an improvement between mean number of correctly answered questions post intervention and at the four-week follow up (p=0.01) as shown in Table III.

Table III. Correct responses for knowledge and self-reported positive behavior questions* (n=47)

	Pre n (%)	Post n (%)	Four- Weeks** n (%)
Knowledge Items			
Gum disease often occurs even when the mouth is properly cleaned	25(53.2)	37(78.7)	20(74.1)
Gum disease may cause serious problems like heart disease	37(78.7)	47(100.0)	25(92.6)
Gum disease is inevitable in people with IDD	30(63.8)	27(57.4)	22(81.5)
If a client has a lot of sugary food and drink, their teeth are more likely to decay	45(95.7)	46(97.9)	25(92.6)
Clients are often on medications that increase their risk of decay	36(76.6)	39(83.0)	24(88.9)
When people with ID get decay, they usually have teeth extracted rather than filled	28(59.6)	26(55.3)	21(77.8)
Ideally, dentures should be carefully placed in the mouth at night	42(89.4)	45(95.7)	26(96.3)
Dentures can cause infection if not cleaned regularly	45(95.7)	45(95.7)	27(100.0)
Gloves worn while brushing the clients' teeth should be rinsed thoroughly between uses	20(42.6)	23(48.9)	22(81.5)
If gums bleed during brushing, they should be brushed less often	45(95.7)	46(97.9)	27(100)
Self-Reported Positive Beha	viors	-	
I always ensure that the client's teeth are brushed at least once a day	46(97.9)	45(95.7)	27(100)
I actively discourage client's from eating sweets	29(61.7)	37(78.7)	22(81.5)
The client's that I care for allow me to do a good job of brushing their teeth	38(80.9)	38(80.9)	14(51.9)
I make sure that the clients' who I care for get a dental check at least once a year	41(87.2)	43(91.5)	25(92.6)

* Knowledge question were coded as either correct=1 or incorrect=0. Behavior question were coded as positive response=1 and negative response=0.

** n=33

Independent sample Mann-Whitney U tests were used to investigate mean differences between the demographic variables *years of experience, education, training,* and *previous oral care training* and the mean number of correct responses at each time point. Years of experience was dichotomized into caregivers with one year or less (n=19) or more than one year (n=28); education was dichotomized into caregivers with a college degree (n=16) and those without (n=31). Training Type/Certifications were dichotomized into caregivers with a CNA or RN license (n=26) and those without (n=18). After accounting for familywise error using a Bonferroni adjustment, there were no significant differences between demographic variables years of experience, education, training, or previous oral care training for the mean number of correctly answered items at each time point (p>0.05).

Behavior

The behavior scale was scored by summing the number of positive oral health behaviors (yes = 1 and no=0) at each time point. The median number of positive oral health behaviors for each time point is shown in Table II and frequency of self-reported positive behaviors is shown in Table III. To examine the effect of the intervention on the positive oral health behaviors, a Friedman test was conducted with the independent variable time of questionnaire completion and the dependent variable median number of oral health behaviors implemented. There was a statistically significant difference in median number of positive oral health behaviors, depending on time of survey completion, $\chi^2(2)=6.6$, p=0.04.

Post-hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, resulting in a significance level set at p < 0.017. Median (IQR) positive oral health behaviors pre-, post- and at the four-week follow up were 3 (3 to 4), 4 (3 to 4) and 3 (3 to 4), respectively. Despite a significant Friedman test, there were no significant differences between pre- and post- intervention (Z=-1.7, p=0.1) or between pre-intervention and four-week follow up (Z=-0.2, p=0.8), or between post intervention and four-week follow up (Z=-2.1, p=0.04) after adjusting for familywise error.

Attitude

The attitude scale was computed by summing the total number of positive responses for oral health behaviors towards all attitude and self-efficacy questions (Agree or Strongly Agree=1, Neither Agree nor Disagree, Disagree, and Strongly Disagree=0) at each time point. The median number of positive responses for attitudes towards oral health behaviors for each time point are shown in Table II. To examine the effect of intervention on positive attitudes towards oral care behaviors, a Friedman test was conducted with the independent variable *time of questionnaire completion* and the dependent variable *median number of positive oral health behaviors.* There was not a statistically significant difference in median number of positive oral health attitudes depending on time of survey completion, $\chi^2(2)=0.5$, p=0.8. Frequency of responses for attitudes is shown in Table IV.

Table IV. Frequency of self-reported positive attitudes and self-efficacy*

	Pre (n=47) n (%)	Post (n=47) n (%)	Four- Weeks** n (%)
I see it as my responsibility to keep client's teeth clean	44(93.6)	45(6.4)	27(100)
In my opinion, it is better to wait until there is a problem before seeking a dental appointment for a client	45(97.8)	44(93.6)	27(100)
Since most people with a learning disability who have some teeth will eventually lose them, regular tooth brushing is not important for them	47(100)	45(95.7)	26(96.3)
Brushing teeth is a very personal thing that you should not be expected to do for somebody else	47(100)	44(93.6)	27(100)
If a client, who needs assistance brushing their teeth, shows any sign of resistance while their teeth are brushed, brushing should be stopped immediately	13(27.7)	10(21.3)	11(23.4)
If a client, who needs assistance brushing their teeth, shows any sign of resistance, an alternative method is attempted.	41(87.2)	45(95.7)	26(96.3)
Self-efficacy			
When I brush a client's teeth I do a very good job	43(91.5)	44(93.6)	23(92.0)
I believe I can help in preventing client's teeth from becoming decayed	42(89.4)	45(95.7)	23(92.0)
I believe I can help in preventing client's teeth from getting gum disease	43(91.5)	44(93.6)	24(92.3)
When I brush a client's teeth I am unsure if I am doing it right	37(78.7)	37(78.7)	25(96.2)
I spend as much time brushing client's teeth as I would like	20(42.6)	22(46.8)	11(42.3)

* Attitude and self-efficacy questions were recoded as agree and strongly agree=positive response and neutral, disagree, and strongly agree as negative response. Positive=1 and negative=0.

**n=33

Independent sample Mann-Whitney U tests were used to investigate median differences between the independent variables *years of experience, education, training type,* and *previous oral care training* for median number of positive responses for attitudes towards oral health behaviors. After accounting for familywise error using a Bonferroni adjustment, there were no significant differences between any groups for median number of positive responses for attitudes towards oral health behaviors (p>.05).

Discussion

The purpose of this study was to measure the impact of an oral health education program on caregivers' oral health knowledge, attitudes, behavior, and self-efficacy in providing oral healthcare to clients with IDD residing in an intermediate care facility. Statistically significant improvements in caregiver knowledge at baseline and at the four-week follow-up were demonstrated. This improvement in knowledge could be have been a result of both the oral health care education intervention and caregiver work experiences between questionnaires. The results also demonstrated slight increases in knowledge for caregivers with less than one-year experience and training, and in those with previous medical training. However, the study participants did not demonstrate any significant changes in their oral health behaviors in regard to actually carrying out oral health care practices with their clients. The oral health behaviors of the participants only increased slightly following the education program and these behavior changes were not sustained as indicated by the four-week follow-up responses. These findings are similar to those of other studies that have identified the need for an ongoing support network following an oral health education intervention to maintain the implementation of positive oral health care behaviors.¹¹⁻¹³

There is clearly a need for a continuous support network to maintain positive intervention changes. Results from this study and previous research suggest that these supportive intervention measures could include activities of daily living care check off sheets that identify the OHC services provided for each patient each day. These daily forms could be reviewed and signed off by the supervising staff, which would improve compliance as well as indicate support for oral health practices from the supervisory staff. Another intervention could include OHC review during staff meetings either quarterly or as needed. Annual or random assessments of caregiver performance in providing daily living care services, including oral health care services could be another avenue for increased compliance.^{11-13,15-16}

Another option to improve the quality of oral care for the population with IDD would be to include oral

health care training into the community-based residential facility (CBRF) certification training programs and other similar programs throughout the country. Currently CBRF training focuses on fire safety, first aid, choking, medication administration, and standard precautions.¹⁸ This program, along with other activities of daily living skill programs could be a point of access to training caregivers on providing daily oral health care services and added into operational protocol for intermediate care facilities. Currently, SWC has a dentist on staff who provides patient restorative care; however, the role is limited to the provision of dental care and the needed education for proper oral health care services is unattainable. One solution would be to add a supervising direct access dental hygienist on staff to address gaps in oral health care education, provide preventive services, and case management of individuals needing restorative dental care. This addition of a dental professional would be the ideal standard of care for this patient population.¹⁶

Limitations to this study included the convenience sample from a single institution located in Wisconsin, and possible bias due to self-reporting of questionnaire responses. The low response rate to the four-week follow-up questionnaire also limited the evaluation of the longer-term effects of the intervention. Future research is needed to investigate the best methods to implement oral health education support systems for residents of intermediate care facilities and to enhance access to care. The dental therapist and advanced dental hygiene practitioner are models being explored in dentistry to increase the access to care for under-served populations, including intellectually and developmentally disabled individuals.¹⁷ These mid-level oral health care providers could be a part of the staff, offer regular educational support, and oversee caregiver oral home care services, while increasing access to dental care services.¹⁷

Conclusion

Results from this study suggest the need for further investigation on the impact of oral health education for caregivers of clients with IDD, as well as the most effective interventions to maintain on-going, quality oral health care provided by caregivers. Programs, such as community-based residential facility certification training, and the utilization of direct access dental hygienists, dental therapists and advanced dental hygiene practitioners on-site, would be opportunities to ensure continuous competence of caregivers in supporting the comprehensive oral health needs of clients with IDD..

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Research

Job Satisfaction, Burnout, and Intention to Leave among Dental Hygienists in Clinical Practice

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Abstract

Purpose: There is limited research about the job satisfaction (JS), burnout (BO), and intention to leave (ITL) amongst dental hygienists in clinical practice providing patient care. The purpose of this study was to explore current trends and the factors influencing JS, BO, and ITL among dental hygienists in their current positions.

Methods: A cross-sectional research study was conducted with a convenience sample of dental hygienists recruited via social media sites. The web-based survey consisted of three previously validated instruments (Job Satisfaction Survey, Oldenburg Burnout Inventory, and Turnover Intention Scale). Descriptive statistics were used to analyze the data.

Results: The survey completion rate was 77% (n=554). Job satisfaction and burnout were associated with five factors related to ITL: frustration, achieving personal-work related goals, considering leaving, accepting another job, job satisfying personal needs, and looking forward to another day at work. Findings indicated that higher levels of JS (β =-0.95, *p*<0.001) predicted decreased ITL while disengagement (β =0.79, *p*<0.001) and exhaustion (β =0.29, *p*<0.001) predicted an increase in ITL (F(3, 554)=141.63, R²=0.44, *p*<0.001). Increased JS predicted a decrease in willingness to accept another job (β =-0.55, *p*<0.001). Disengagement predicted a higher willingness to accept another job (β =0.60, *p*<0.001) however exhaustion did not (β =0.09, *p*<0.001; F(3, 554)=46.89, R²=0.20, *p*<0.001).

Conclusion: Findings suggest there is overall job satisfaction amongst dental hygienists in clinical practice with the exception of the lack of fringe benefits and opportunities for promotion. Employers may need to identify ways to address these concerns to retain qualified dental hygienists. In addition, employers need to be proactive in addressing factors impacting burnout and dental hygienists' intent to leave their positions.

Keywords: dental hygienists, burnout, job satisfaction, intention to leave, career longevity, occupational health

This manuscript supports the NDHRA priority area, **Professional Development: Occupational Health** (Career satisfaction and longevity)

Submitted for publication: 5/19/20; accepted: 9/8/20

Introduction

Dental hygienists play an important role in oral health promotion and disease prevention by serving in a multitude of roles that include the provision of patient care in a variety of clinical settings including direct access care, public health clinics, and dental service organizations (DSO). Dental service organizations are growing in popularity as they provide administrative services to dental practices that are operated by dentists. This type of business model support allows dentists to focus on patient care without worrying about administrative and practice management duties.

Considering the emerging associations between oral and systemic health along with more Americans retaining their

teeth for a lifetime, there has been an increasing demand for preventive oral health care.^{1,2} Dental hygienists are positioned to help meet the 11% growth projection of the Bureau of Labor (2018 - 28), more than double the average 5% growth for all careers in the United States(US).³ While growth for dental hygiene is greater than many other careers, there has been little research conducted to evaluate issues affecting the longevity of dental hygienists, such as job satisfaction (JS), burnout (BO), and intention to leave (ITL).⁴⁻⁶ However, these factors have been shown to be of significant concern in other health care professions, especially in nursing, particularly with longer hours and increases in workloads.⁷⁻⁹ It is important to understand whether longer hours and increased workloads will have a similar effect on dental hygienists as demands in the profession increase.

Literature reveals JS, BO, and ITL influence each another and have similar results.^{7,10,11} One common finding suggests that autonomy over the health care provider's work and responsibilities impacted their JS, BO, and ITL.^{4,9,10,12} Another common finding was the impact of empowerment on clinicians' attitudes toward their jobs and work performance.^{8-10,12,13} Autonomy and empowerment were associated with higher JS, which appeared to have the greatest impact on decreasing BO and ITL.^{9,11,14-16}

Several other factors have been shown to influence JS, BO and ITL. Strong leadership and support from management were identified as important factors for clinicians to perform their duties proficiently, and decreased BO and ITL.^{5,10,11,16} Health care providers also should also have a good work-life balance, without excessively long working hours, to prevent BO and have JS.^{5,14,15,17} In addition, having adequate staffing to meet the job demand played a key role in JS in order to prevent BO and turnover.^{9,11,14,16}

As the dental hygiene profession grows to help meet the increased demand for preventive care, it is important to understand and explore factors affecting the dental hygiene profession in regard to JS, BO, and ITL. There is a gap in the literature examining the specific career longevity implications for dental hygienists. The purpose of this study was to investigate job satisfaction, burnout, and intention to leave an employment position among dental hygienists and explore the current trends and influencing factors.

Methods

The MCPHS University's Institutional Review Board gave this study exempt status; protocol number IRB121018B. A cross-sectional survey research design was used with a convenience sample of dental hygienists in clinical practice. The web-based survey was administered via SurveyMonkey[®] (San Mateo, CA). Participants were recruited from Facebook, a popular social media site and widely used in the US. The dental hygiene Facebook groups were identified by using search terms such as dental hygiene, dental hygienist, RDH, and dentistry. Facebook groups with dental hygiene membership of at least 7000 followers were chosen for participant recruitment.

Sample population

The target population for the study was registered dental hygienists who were actively providing patient care in the US. Dental hygienists who had practiced for less than one year or who were no longer actively providing patient care were excluded from the sample. These criteria ensured that the participants would have appropriate amount of experience to provide their perspectives and evaluate the variables. A power analysis was conducted using G*Power. For chi-square test of independence, analysis recommends 133 participants to achieve 80% power to detect a medium effect size using alpha=.05 and five degrees of freedom.

Instrument

Three validated surveys were combined into one instrument for a total of 58 items. The final instrument consisted of Job Satisfaction Survey (36 items); Oldenburg Burnout Inventory (16 items); Turnover Intention Scale (6 items). Each item used a Likert scale to measure the responses and the scales varied from 4- to 6-point scales. Reverse scoring on select items was used to minimize response bias.

There were nine sub-scales on the job satisfaction items including: pay, promotion, supervision, fringe benefits, contingent rewards, operating procedures, coworkers, nature of work, and communication. The sub-scale Cronbach alpha ranged from 0.60 to .082 with an overall internal consistency of 0.91. The Job Satisfaction Survey had good reliability based on the test-retest correlation with a Cronbach alpha coefficient above 0.70 or an internal consistency above 0.80.18 Validation of the instrument showed a test-retest correlation of 0.71.18 The Oldenburg Burnout Inventory has been shown to have good reliability in assessing burnout.^{19,20} Internal consistency for the sub-scales was shown to be 0.73 to 0.87 for exhaustion and 0.81 to 0.83 for disengagement. 19,20 The $\,$ Turnover Intention Scale also demonstrated good reliability and validity.²¹ Previous studies showed a test-retest correlation of 0.895 to 0.913.^{22,23} Since this study intended to measure dental hygienists with working experience of at least one year, there is the possibility of loss of some reliability, as the instrument was reported to have the most reliability when completed within the first 6 months of employment.²⁴

Procedure

After gaining permission from the Facebook page administrators, an invitation to participate in the research was posted on the group pages with a link to web-based survey platform. Participants were required to read and agree to the informed consent document in order to access the survey. The survey was estimated to take 15 to complete. A follow up invitation was posted one week after the initial invitation to participate. No participation incentives were provided.

Statistical Analysis

Descriptive analysis was used for the data collected using the Likert scale for items and to evaluate normality and linearity. Mean, median, and frequency were used for the continuous variables to simplify the large amount of data. Using the frequency distribution, the data was categorized or used as individual values. Standard deviation was used as a measure for variance to help estimate the amount of dispersion of data. Internal consistency was measured by using Cronbach's alpha of 0.7 and the covariance was also measured between two variables. Multiple variable regression was used to help predict the dependent values of an independent variable based on two or more variable values. The interval estimate used was 95% confidence interval (95% CI). In addition, the probable value (p value) was set to 0.05. The last analysis used was the chi-squared test (χ^2) to understand the likelihood the observed distribution was due to chance. The data was analyzed using SPSS 23 (IBM, Armonk, NY).

Results

A total of 723 individuals opened the survey link; and the completion rate was 77% (n=554). Most participants were employed in private practice (87%) and worked more than 3-4 days a week (89%). A little less than half of participants (41%) had been practicing for fewer than 10 years. Demographic information is shown in Table I.

Coding of the Job Satisfaction Survey was arranged so higher values indicated higher job satisfaction. Each subscale was calculated by averaging responses after reverse coding was completed. Participants job satisfaction averaged slightly above the neutral response for supervisors (M=4.30, SD=1.22), coworkers (M=4.44, SD=1.06), and the nature of the work (M=4.70, SD=1.11). Provision of fringe benefits (M=2.72, SD=1.39) was the only response to fall below the neutral response point. Over 68% disagreed with the statement "we receive benefits as good as most other organizations" and 77% agreeing with the statement "there are benefits we do not have which we should have". The nine subscales showed excellent reliability (α =0.83). The nine subscales were combined into a total job satisfaction scale by averaging all items into a single score (M=3.80, SD=0.70). The averages and standard deviations for all Job Satisfaction Survey subscales are displayed in Table II.

The Oldenburg Burnout Inventory contained disengagement and exhaustion subscales; higher values indicated more disengagement and exhaustion in the workplace. Both subscales were calculated using the average response for the items related to the respective scales. On average, participants fell below the neutral mid-point response for disengagement (M=2.41, SD=0.55) and exhaustion (M=2.33, SD=.54), indicating that participants did not experience disengagement or exhaustion in the workplace. Responses to each of the Oldenburg Burnout Inventory items are shown in Table III.

One-way ANOVA and independent sample t-tests were conducted to investigate mean differences between categories of demographic Table I. Sample demographics (n=554)

	n	%
Gender		
Male	7	1.26
Female	547	98.74
Age range		
20-25	36	6.49
26-30	67	12.07
31-35	77	13.87
36-40	90	16.22
41-45	67	12.07
46-50	64	11.53
51-55	59	10.63
56-60	52	9.37
61-65	38	6.85
66 and over	5	0.90
Employment setting		
Community Health Center	16	3.00
Dental Service Organization	26	4.88
Private practice	465	87.24
Federal employment (VA Hospital, Prison, etc)	11	2.06
Public health	15	2.81
Other	0	0.00
Number of hours worked per v	week	
Not working currently	0	0.00
1-2 days	59	10.63
3-4 days	345	62.16
5+ days	151	27.21
Years of practice		
1-5	133	23.96
6-10	93	16.76
11-15	70	12.61
16-20	69	12.43
21-25	59	10.63
26-30	35	6.31
31-35	41	7.39
36-40	30	5.41
41+	25	4.50

	Mean	Standard Deviation
Pay	3.58	.72
Promotion	3.69	.55
Supervisor	4.30	1.22
Fringe Benefits	2.72	1.39
Reward	3.18	1.27
Operations	3.69	1.02
Coworkers	4.44	1.06
Nature of work	4.70	.99
Communication	3.88	1.12

Table II. Job satisfaction subscales (n= 554)

variables. There were statistically significant differences in mean job promotion/job satisfaction (F(2, 554)=7.43, p=0.001) and fringe benefit satisfaction (F(2, 554)=8.55, p<0.001). Posthoc comparisons using Tukey's HSD showed participants working less than 3 days a week had higher job promotion/job satisfaction (M=3.94, SD=0.67) than those working three

to four days (M=3.68, SD=0.50, p=0.001) or those working five days or more (M=3.63, SD=.56, p=0.001). Participants employed in the working three to four and five plus days per week categories, did not have a significant difference in mean satisfaction levels (p=0.65). For fringe benefits, participants working fewer than three days a week (M = 2.23, SD = 1.16) had lower job satisfaction than those working three to four days a week (M=2.65, SD=1.36) and those working five days or more (M=3.05, SD=1.49, p=0.001). Participants in the three to four and five or more days per week groups did not have statistically different means (p = 0.07). Participants working in a DSO setting were compared to participants in all other practice types using independent t-tests. Participants who were DSO employees indicated greater satisfaction with opportunities for promotion (M=3.70, SD=0.54) than participants employed in other settings (M=3.44, SD=0.61, p=0.02). The DSO participants were also more satisfied with their fringe benefits (M=3.98, SD=1.19) than non-DSO participants (M=2.65, SD=1.37, p < 0.001). All other comparisons for demographic variables were non-significant (p>0.05).

Table III. Oldenburg Burnout Inventory (OLBI) responses (n=554)

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
I always find new and interesting aspects in my work.	58	10.47	255	46.03	190	34.30	51	9.21
It happens more and more often I talk about my work in a negative way.	97	17.51	212	38.27	187	33.75	58	10.47
Lately, I tend to think less at work and do my job almost mechanically.	95	17.12	265	47.75	163	29.37	32	5.77
I find my work to be a positive challenge.	60	10.81	297	53.51	176	31.71	22	3.96
Over time, one can become disconnected from this type of work.	164	29.66	300	54.25	78	14.10	11	1.99
Sometimes I feel sickened by my work tasks.	45	8.11	129	23.24	278	50.09	103	18.56
This is the only type of work that I can imagine myself doing.	67	12.09	153	27.62	236	42.60	98	17.69
I feel more and more engaged in my work.	28	5.06	202	36.53	276	49.91	47	8.50
There are days when I feel tired before I arrive at work.	200	36.10	272	49.10	64	11.55	18	3.25
After work, I tend to need more time than in the past in order to relax and feel better.	157	28.39	227	41.05	138	24.95	31	5.61
I can tolerate the pressure of work very well.	82	14.77	342	61.62	114	20.54	17	3.06
During my work, I often feel emotionally drained.	123	22.16	221	39.82	181	32.61	30	5.41
After working, I have enough energy for my leisure activities.	21	3.78	155	27.93	271	48.83	108	19.46
After my work, I usually feel worn out and weary.	164	29.55	252	45.41	113	20.36	26	4.68
Usually, I can manage the amount of my work well.	133	24.01	379	68.41	39	7.04	3	0.54
When I work, I usually feel energized.	21	3.78	225	40.54	251	45.23	58	10.45

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Five separate linear regression models were calculated to determine if overall JS, disengagement, and exhaustion predict responses to the five intention and attitude questions (Table IV). The linear regression model indicated all five models were statistically significant. Job satisfaction was a significant predictor in four of the five models, except for the frequency of looking forward to another day at work. Higher JS predicted lower frustration about opportunities to achieve work related goals (p<0.05), consideration about leaving a current employer (p<0.001), and willingness to accept an equal job offer (p<0.001). Satisfaction predicted higher frequency of looking forward to another day at work. Disengagement was a significant predictor in all five models. Higher average disengagement responses predicted more frustration (p<0.001), consideration about leaving a current employer (p<0.001) and predicted a lower frequency of looking forward to another day at work (p<0.001) and predicted a lower frequency of looking forward to another day at work (p<0.001). Exhaustion was a significant predictor in all models except for being frustrated when not given an opportunity to achieve personal work-related goals. Exhaustion followed the same predictive pattern as disengagement. Results of regression analysis including beta values are shown in Table V.

Table IV. Turnover intention s	cale (TIS-6) res	ponses (n=554)
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	1=Never		2		3		4		5=Always	
	n	%	n	%	n	%	n	%	n	%
How often do you dream about getting another job that will better suit your personal needs?	75	13.5	89	16.1	131	23.6	96	17.3	163	29.4
How often are you frustrated when not given the opportunity at work to achieve your personal work-related goals	101	18.2	109	19.7	157	28.3	92	16.6	95	17.1
How often have you considered leaving your job?	69	12.5	111	20.0	124	22.4	111	20.0	139	25.1
How often do you look forward to another day at work?	171	30.8	133	24.0	153	27.6	79	14.2	19	3.4
	1=H Unli	ighly ikely	2	2		3	4	4	5=H Lik	ighly cely
	n	%	n	%	n	%	n	%	n	%
How likely are you to accept another job at the same compensation level should it be offered to you?	181	32.7	90	16.2	106	19.1	65	11.7	112	20.2
	1=To a very large extent		2		3		4		5=To no extent	
	n	%	n	%	n	%	n	%	n	%
To what extent is your current job satisfying your personal needs?	67	12.1	124	22.4	214	38.6	101	18.2	48	8.7

Discussion

Dental hygienists play an important role in the management of the patient's preventive oral care; however, there is little research investigating career longevity issues such as JS, BO, and ITL in the dental hygiene profession. Results from this study identified several trends influencing JS, BO, and ITL among dental hygienists. First, job satisfaction had a strong influence on intention to leave in this population, similar to research conducted among registered nurses.^{10,12} A second finding was that burnout, characterized by exhaustion and disengagement, also has a strong influence on ITL. Third, disengagement had a stronger influence than exhaustion on BO based on the predictors used in this study. Previous research conducted among registered nurses demonstrated that JS, BO, and ITL correlated with one another and was very similar to the findings in this study.⁷⁻⁹

Iob satisfaction showed several key trends in the analysis. First, this research found dental hygienists who felt less frustrated were more satisfied with their work and less likely to consider leaving a job or accepting another position. While frustration was not defined in the survey it could result from multiple factors such as job demand, time pressure, stress, or feeling overloaded or overwhelmed by work. Previous research has reported these factors were also of important indicators of job satisfaction in nursing.7,9,10,12

In this study, respondents were only slightly satisfied with

	B(SE)	β	R ²	F(3, 555)
Frustration	.44	141.63***		
Job satisfaction	95(.08)	50***		
Disengagement	.40(.12)	17***		
Exhaustion	.15(.13)	06		
Consider leaving			.53	202.57***
Job satisfaction	73(.08)	38***		
Disengagement	.79(.12)	32***		
Exhaustion	.29(.12)	12**		
Accept another job	.20	46.89***		
Job satisfaction	55(.11)	25***		
Disengagement	.60(.17)	22***		
Exhaustion	.09(.17)	03		
Personal needs			.19	43.25***
Job satisfaction	27(.08)	17**		
Disengagement	.37(.12)	19**		
Exhaustion	.29(.13)	14**		
Looking forward	.33	89.25***		
Job satisfaction	.12(.08)	.07		
Disengagement	85(.12)	.40***		
Exhaustion	32(.12)	.15**		

Table V. TIS-6 Subscales predicting burnout and job satisfaction regression models* (n=555).

*SE=Standard error of the unstandardized beta weight. For each of the five separate models, one of the Turnover Intention Scale (TIS-6) subscale scores predicted overall job satisfaction (JSS), disengagement (OLBI), exhaustion (OLBI).

p*<0.05, *p*<0.001

pay and rewards. As reported in the literature for nursing and physician assistants, poor reward systems and pay can result in dissatisfied employees and increased turnover.9,25,26 The correlation to increased turnover has the potential to impact the overall patient care experience in addition to having economic implications for employers.9,27 Fringe benefits also played a significant role in JS (p<0.001) for the study participants. Although the specific benefits were not identified, some possibilities may include medical and dental insurance, educational assistance, paid vacation, paid sick time, or retirement (e.g. 401(k) retirement account). Research conducted among other health professions has indicated that health insurance and other fringe benefits have been significantly associated with job satisifaction.^{28,29} In this study, participants working fewer than three days a week were less satisfied with fringe benefits than participants employed four or more days. This could be related to the respondents employed more than four days a week were more likely to meet the minimum hours required to receive fringe benefits.

Participants employed by a DSO were more satisfied with opportunities for promotion (p=0.02) and fringe benefits (p<0.001) than non-DSO participants, similar to findings reported from a survey of dentists.³⁰ Dental service organizations contract with dental practices to provide management support with non-clinical operations. In the DSO corporate structure, dental hygienists have opportunities to explore careers outside of clinical practice including mentoring, education, practice management, or career opportunities with the corporate office. Furthermore, these non-clinical positions can be offered as promotions that include pay raises, bonuses, or incentives. Fringe benefits are also more common in the DSO employment model.

Operations or organizational structure was also an area where respondents reported only slight satisfaction in the Job Satisfaction Survey. Organizational structure may include formalization of policies and procedures; participation in decision-making; and opportunities for growth. Operations in a dental practice include, but are not limited, the workforce or staffing, work hours/shifts, and work-life balance, all important aspects of preventing burnout and increasing job satisfaction. Research has shown that an organizational structure with good management, support staff, and leadership can also lead to higher job satisfaction in health care settings.^{10, 12}

In any health care environment, communication is critical among team members as a lack in communication can lead to frustration, job dissatisfaction, impact retention, and ultimately impact patient care.¹⁴ When effective teamwork and communication is utilized, it can help with workflow, reduce errors, and increase productivity.³¹ Results from this showed only slight satisfaction with communication, which is an area that requires further exploration as it was inconsistent with findings in other health professions such as nursing.¹⁴

Regression models indicated disengagement was related to frustration with personal work-related goals (p<0.001), considering leaving a job (p<0.001), likelihood of accepting another job (p<0.001), satisfaction of personal needs (p<0.05), and looking forward to another day at work (p<0.001). Employers understanding the goals and needs of the individual dental hygienist and offering opportunities for growth could address some of these predictors for disengagement. A possible way to overcome disengagement may include supporting the dental hygienist's autonomy in decisions related to providing quality preventive care and fully utilizing the scope of practice allowed in the state, such as administering local anesthetics; administering nitrous oxide; and placing and finishing restorations.^{4,8,31} In addition, a majority of states (42) allow for the delivery of dental hygiene care in alternative practice settings.³² A dental practice could consider engaging appropriately qualified dental hygienists to go to these settings to provide preventive care as personalized outreach for their practice.³² Allowing for dental hygienists to practice to the full-extent of their education and license can lead to greater engagement and retention.

When examined exclusively, exhaustion appeared to add to the indicators of considering leaving a job (p<0.05), the job satisfying personal needs (p<0.05) and looking forward to another day at work (p<0.05). Understanding the causes of mental and physical fatigue are key factors for identifying ways to prevent and/or manage BO. A previous study reported that 29% of the dental hygienists experienced BO due to factors including difficult or demanding patients, work-life balance, and long hours.⁵ Burnout may also be a result of factors such as accelerated dental hygiene schedules, shorter patient appointment times, inadequate lunch breaks, or lack of staff support.

There were limitations to this study. Use of a nonprobability sample from targeted social media groups, limits generalizability. Many surveys were not completed, which may have been due to the length of the survey. Self-report bias may have also influenced the participant responses. Another concern was possible misinterpretation of survey terminology, such as confusion in interpretation of the question or rating for the Likert scale. As the majority of the participants worked in private practice, limiting the understanding of other types of employment settings. Future research should investigate the factors with the greatest impact in preventing burnout and improving job satisfaction and include a wider range of practice settings. Based on the findings from this study, further research on the DSO employment setting and career longevity are warranted. Given that this research was completed prior to the COVID-19 pandemic, changes in job satisfaction, burnout, and intention to leave among clinical dental hygienists are unknown and need further investigation.

Conclusion

Results from this study suggest that there is overall job satisfaction amongst dental hygienists in clinical practice with the exception of the lack of fringe benefits and opportunities for promotion in the job setting. Overall satisfaction with employment and burnout were shown to be influencers for leaving a clinical dental hygiene position. Findings suggest that employers should explore ways to support dental hygienists in meeting their work-related goals for continued growth and career longevity. A proactive approach in addressing factors impacting burnout and dental hygienists' intent to leave their positions may ultimately contribute to improved patient care and positive oral health outcomes.

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Research

Reducing the Risks for Musculoskeletal Disorders Utilizing Self-Assessment and Photography among Dentists and Dental Hygienists

Brian B. Partido, RDH, MSDH; Rebecca Henderson, RDH, MS

Abstract

Purpose: Prolonged muscle strain and repetitive movements in the dental workforce may lead to work-related musculoskeletal disorders (WMSDs). The purpose of this study was to determine whether feedback involving photography and self-assessments would improve the postures and the accuracy of ergonomic self-assessment among practicing dentists and dental hygienists.

Methods: A convenience sample of dentists and dental hygienists was used for this randomized control design study (n=50). The Modified-Dental Operator Posture Assessment Instrument (M-DOPAI) was used for ergonomic evaluations of the randomly assigned control and experimental (training) groups over a four-week period. All participants were photographed and completed a M-DOPAI without viewing the photographs or receiving feedback at baseline. Participants in the control group independently completed a M-DOPAI without any additional photographs or feedback during weeks two and three. The experimental group had additional photographs taken and completed a M-DOPAI along with the principal investigator. Mixed-design ANOVAs were used to evaluate improvements in ergonomic scores and the accuracy of ergonomic self-assessments.

Results: The training group utilizing photography resulted in improvements in ergonomic scores as compared to the control group. Improvements in the accuracy of ergonomic self-assessments was demonstrated among practicing dental hygienists. All participants strongly agreed that it was important to understand and properly apply ergonomics, and to develop accurate ergonomic self-assessment skills for clinical practice.

Conclusion: Improving self-awareness for ergonomics through self-assessment can help reduce the risk of developing WMSDs among practicing dentists and dental hygienists.

Keywords: musculoskeletal disorders, ergonomics, postures, self-assessment, dental hygienists, dentists

This manuscript supports the NDHRA: **Professional development (Occupational health)** methods to reduce occupational stressors.

Submitted for publication: 2/17/20; accepted: 8/26/20

Introduction

Prolonged muscle strain and repetitive movements in the dental workforce may lead to work-related musculoskeletal disorders (WMSDs).¹ The prevalence of WMSDs affects the majority of dental professionals. De Sio et al. reported that 54-93% of dental professionals suffer from work related pain² whereas Hayes et al. found that approximately 68% of dental clinicians experienced pain in the neck, lower back, and shoulders.³ Over time, the gradual severity of WMSDs may lead to increased physical limitations and the eventual inability to work.

Dentists and dental hygienists often adopt asymmetric and compromised postures, such as having the head flexed forward

or the shoulders slumped forward or elevated above line of the trunk.⁴ Over time, muscles and joints become strained – triggering symptoms such as backache, headache, neck and shoulder pain.⁵ By improving and maintaining neutral postures, dental hygienists can reduce the risks of developing WMSDs through ergonomics.^{6,7} Ergonomics is defined by the scientific discipline of modifying techniques, designing equipment, and transforming working spaces to maximize the clinician's safety and efficiency and minimize operator pain and fatigue. Possessing the theory of ergonomics, however, is insufficient to prevent WMSDs. Despite having knowledge of ergonomics concepts, Cervera-Espert et al. found that only 28.6% of dental clinicians demonstrated acceptable and uncompromised postures.⁸ This disparity between the theory and the application of ergonomic concepts can be mitigated with postural modifications discovered through self-awareness and self-assessment.

Self-assessment is an accurate evaluation of oneself based on specific criteria.⁹⁻¹¹ Bowers and Wilson stated that selfassessment had positive effects on dental hygiene education and clinical practice.¹² Ergonomics training using self-assessment and photography has been shown to improve the postures and the accuracy of ergonomic self-assessments among dental hygiene students.⁵ However, it is not known whether this type of ergonomics training, involving self-assessments and photography, would be effective with practicing clinicians. The purpose of this study was to determine whether feedback involving photography and self-assessment would improve the postures and the accuracy of ergonomic self-assessments among practicing dentists and dental hygienists.

Methods

This study received approval from The Ohio State University Institutional Review Board (2018H0157). A randomized controlled design was used with two parallel groups. A convenience sample of dentists and dental hygienists, employed at The Ohio State University Dental Faculty Practice, was recruited by the principal investigator (PI) (n=50). The following inclusion criteria were used for the participants: an active Ohio dentist (DDS) or Registered Dental Hygienist (RDH) license; currently involved in at least 8 hours of clinical practice per week; available to commit to the time requirements of the study. Following the provision of the study details and a question-and-answer session, participants signed an informed consent document prior. As determined with G-power (Dusseldorf, Germany), a sample of 50 participants would yield a power of 0.80, which would determine whether the intervention had a true effect on the population. The PI used the randomization feature in SPSS Version 26 (IBM, Armonk, NY, USA) to generate a random list of random numbers to assign participants to the control and experimental (training) groups. The PI kept all research personnel blinded to the random assignment.

Instruments

The Modified-Dental Operator Posture Assessment Instrument (M-DOPAI) was used for the participants' ergonomic self-assessments and the raters' ergonomic evaluations.^{13,14} The M-DOPAI combined Branson et al. Posture Assessment Instrument, which was tested for validity and reliability for of ten of the twelve criteria,¹⁵ and Maillet et al.¹⁶ Posture Assessment Criteria.¹⁶ Each criterium had one of three categories: acceptable (one point), compromised (two points), or harmful (three points). The ergonomic scores ranged from a total of 12 points (most acceptable posture) to 32 points (most harmful postures).

Digital photographic images were captured using a 10.5inch iPad Pro (Apple, Cupertino, CA, USA). The flash and sound options were disabled to minimize any disruptions to the participants. The size of the screen allowed the PI to readily review the photographs with the participants and/or patients. All images were stored in the secure Buckeye Box, which was only accessible to the PI and key personnel.

A survey instrument was used to evaluate for changes in attitudes about musculoskeletal disorders and ergonomics. The pre- and post-test surveys had two items, with 5-point Likert-scale attributes ranging from 1-strongly agree to 5-strongly disagree. The questions were modeled after existing attitudinal survey questions.^{13,14} The post-test survey included one open-ended question for general comments about the study. The survey was administered through Qualtrics (Provo, Utah, USA). Survey invitations were sent at week one and after the conclusion of the study at week four.

Procedures

Data collection occurred through a four-week period. At week one, all participants were photographed twice (front and profile) and completed an ergonomic self-assessment (M-DOPAI) without viewing the photographs or receiving feedback (Figure 1). Prior to completing the self-assessment, the same general instructions were given to each participant. During weeks two and three, participants in the control group independently completed an ergonomic self-assessment

Figure 1. Sample of captured posture images (profile and front views)





(M-DOPAI) without any additional photographs or feedback from the PI. Participants in the experimental training group had two additional photographs taken (front and profile) and completed an ergonomic self-assessment (M-DOPAI) with the PI. The PI had conducted multiple research studies involving the evaluation of postures, facilitating selfassessment of postures, and the calibration training of raters in the evaluation of postures. The PI facilitated the selfassessments by allowing each participant to self-assess their postures using each of the 12 criteria of the M-DOPAI. The PI would either agree or disagree with the participants' selfassessment and would discuss how to remedy any postural deficiencies. At week four, all participants were photographed twice (front and profile) and independently completed an ergonomic self-assessment (M-DOPAI) without viewing the photographs or receiving feedback.

After the four weeks of data collection, the photographs from week one and week four were evaluated for ergonomic scores. The raters consisted of two faculty members and two dental hygiene students enrolled in the The Ohio State University Dental Hygiene Program. All raters received a 30-minute calibration training from the PI, which consisted of a discussion of ergonomic principles, how to recognize harmful postures, and practicing ergonomic evaluations using sample photographs. Each rater evaluated the week one and week four photographs independently. The PI determined consensus with the scores. Interrater reliability was measured at a Cronbach's alpha level of 0.797 and intraclass correlation of 0.789, 95% CI [.697-.861].

Data analysis

The data were analyzed using SPSS version 26 (IBM, Armonk, NY, USA). A mixed-design ANOVA was used to evaluate improvements in ergonomic scores from week one to week four and a mixed-design ANOVA of Kappa values was used to evaluate improvements in the accuracy of ergonomic self-assessments. The accuracy of ergonomic self-assessments was calculated using Cohen's Kappa coefficient, which ranged from less than 0 (no agreement) to 1 (prefect agreement). Kappa values fell into the following ranges: 0.00 to 0.20 (slight), 0.21 to 0.40 (fair), 0.41 to 0.60 (moderate) and 0.61 to 0.80, and 0.81 to 1.0 (perfect).¹⁷ A, mixed-design ANOVA was used to evaluate differences in attitudes regarding ergonomics among the participants. The open-ended responses were categorized by the benefits and challenges of the intervention.

Results

Fifty-two licensed dentists and registered dental hygienists were recruited to participate in the study; two individuals were unable to participate. With this convenience sample (n=50),

25 participants were randomly assigned to either the control or to the experimental training group. Independent sample t-tests revealed no significant differences between the two groups based on gender, age in years (M=48.73, SD=13.82), hours in clinical practice (M=18.22, SD=13.85), and years in clinical practice (M=24.13, SD=14.94) (p>.05).

The first aim was to determine whether ergonomics training utilizing photography would improve ergonomic scores among practicing dentists and dental hygienists. A 2x2 mixed-design ANOVA was used to evaluate the effects of group (control and training group) and time (pre-test and post-test) on ergonomic scores. Significant interactions were found with time x group (F(1,3)=6.043, p=.015). Significant main effects were found with time (F(1,3)=18.209, p<.001) and group (F(1,3)= 4.356, p=.038. Post hoc one-way ANOVA revealed no significant differences in pre-test ergonomic scores of the training group (M=17.14, SD=3.270, 95% CI [16.21-18.07]) compared to the control group (M=16.98, SD=3.583, 95% CI [15.96-18.00], F(1,98)=.054, p>.05) but significant improvements in post-test ergonomic scores of the training group (M=14.24, SD=1.779, 95% CI [13.73-14.75]) compared to the control group (M=16.20, SD=3.239, 95% CI [15.28-17.12], F(1,98)=14.066, p<.001). The training intervention resulted in a significant improvement on ergonomic scores (Table I).

The second aim was to determine whether ergonomics training utilizing photography would improve ergonomic scores among practicing dentists and dental hygienists. A 2x2 mixed-design ANOVA was used to evaluate the effects of group (control and training group) and time (pre-test and post-test) on the accuracy of ergonomic self-assessments. A significant interaction was found with time x group (F(1,3)=2.769, p=.041) and a significant main effect was found with group (F(1,3)=6.583, p=.012). Post hoc oneway ANOVA revealed no significant differences in pretest accuracy of ergonomic self-assessments of the training group (M=.127, SD=.193, 95% CI [.047-.207]) compared to the control group (M=.088, SD=.127, 95% CI [.036-.140], F(1,48)=.715, p>.05) but significant improvements in posttest accuracy of ergonomic self-assessments of the training group (M=.278, SD=.338, 05% CI [.139-.418]) compared to the control group (M=.095, SD=141, 95% CI [.037-.153], F(1,48)=6.251, p=.016). The training intervention resulted in a significant improvement on the accuracy of ergonomic selfassessments (Table I).

The third aim was to evaluate for changes in attitudes about musculoskeletal disorders and ergonomics among practicing dentists and dental hygienists. A 2x2 mixed-design ANOVA

Tuble 1. Descriptive and summary statistics from repeated measures in to this comparing intervention and control condition
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	Intervention Group	Control Group	Interaction Effects Main Effects		Effects			
	(n=25)	(n=25)	Time x	Group	Ti	me	Gro	oup
	M (SD) 95% CI	M (SD) 95% CI	F	Sig	F	Sig	F	Sig
Ergonomic scores			6.043	.015*	18.209	< .001 *	4.356	.038*
Pre-test (Week 1)	17.14 (3.27) [16.21-18.07]	16.98 (3.58) [15.96-18.00]						
Post-test (Week 4)	14.24 (1.78) [13.73-14.75]	16.20 (3.24) [15.28-17.12]						
Accuracy of self-assess	sments		4.169	.041*	3.342	>.05	6.583	.012*
Pre-test (Week 1)	.127 (.193) [.047207]	.088 (.127) [.036140]						
Post-test (Week 4)	.278 (.338) [.139418]	.095 (.141) [.037153]						

* *p*-values <.05

Table II. Descriptive and summary statistics comparing attitudes between training and control groups

		Intervention Group (n=25)		Control Group (n=25)					
	week	M	SD	95% CI	М	SD	95% CI	F	Sig
It is important for <i>dentists and dental</i>	1	1.20	.41	[1.03-1.37]	1.13	.34	[.98-1.28]	.404	>.05
<i>hygienists</i> to understand and apply proper ergonomics in clinical practice.	4	1.11	.32	[.95-1.26]	1.10	.31	[.96-1.24]	.719	>.05
It is important for <i>dentists and dental</i>	1	1.16	.37	[1.01-1.31]	1.26	.45	[1.07-1.46]	.003	>.05
<i>bygienists</i> to have accurate ergonomic self- assessment skills in clinical practice.	4	1.26	.56	[99.1.53]	1.10	.31	[.96-1.24]	1.282	>.05

was conducted to determine any differences in attitudes from week one to week four. No significant differences were found in attitudes between the control and training groups (p>.05) (Table II). All participants either agreed or strongly agreed that it was important for both dentists and dental hygienist to understand proper ergonomics, apply proper ergonomics, and have accurate ergonomic self-assessment skills while in clinical practice. From the open-ended questions in the post-study survey, the respondents reported benefits from the "increased awareness of their postures" from their participation in the study and the challenges of "self-assessing without a mirror" and not achieving "ideal postures depending on the patient."

Discussion

The purpose of this study was to determine whether feedback involving photography and self-assessment would improve the postures of practicing dentists and dental hygienists. The ergonomics training utilizing photography resulted in improvements in ergonomic scores and the accuracy of ergonomic self-assessments among the dentists and dental hygienists. Although the participants understood the importance of proper ergonomics, much potential remains for improvements in the postures of dentists and dental hygienists engaged in clinical practice.

Dentistry is a physically demanding occupation in which the failure to maintain balanced and neutral postures may result in the development of work-related musculoskeletal disorders (WMSDs).^{1,7} Anecdotally, based on the rater evaluations, the most recurring compromised area of the body during the evaluations was the forward flexion of the head. Pain associated with the neck area has been identified as one of the most common sources of pain for dental hygienists.¹⁻⁴ Many times, dental clinicians fail to recognize the importance of ergonomic postures until after the initiation of pain.¹⁸ This finding emphasizes the importance of maintaining neutral, balanced postures while practicing dentistry and dental hygiene.

Although magnification loupes are perceived as preventative measures, they may also be the source of musculoskeletal problems with compromised or harmful positions of the head, such as the observed forward flexion of the head identified in this study. In theory, either through-the-lens (TTL) or flip-up magnification loupes, when properly selected and adjusted, can support balanced musculoskeletal ergonomic and provide working distances to keep the body upright and enhance clinical performance.9,10 However, 82% of surveyed dental professionals were found to have been practicing with coaxial misalignment of their magnification loupes, which do not support the optimal visual acuity or neutral postures.¹⁹ In addition, if the angle of declination of through-the-lens (TTL) magnification loupes is limited to 30 degrees, the natural tendency of the clinician is the forward flexion of the head. The neck, shoulders, and upper back have been reported as the most common sources of pain for dental hygienists.²⁰ Future research is needed to determine whether the angle of declination of TTL magnification loupes can be increased to angles greater than 30 degrees or whether flipup magnification loupes may provide increased angles of declination to prevent the forward flexion of the head.

In this study, the accuracy of ergonomic self-assessments of the practicing dentists and dental hygienists was initially in the slight agreement range for all participants and increased to the moderate agreement range for the training group. In a previous study of dental and dental hygiene students undergoing a similar intervention, the accuracy of ergonomic self-assessments increased from slight to fair agreement.^{13,14} The main difference was that the dental and dental hygiene students overestimated the correctness of their postures whereas the practicing dentists and dental hygienists underestimated the correctness of their postures. Since dental and dental hygiene students are still learning the technical aspects of the dental hygiene profession, less attention may be placed on maintaining neutral postures. For experienced dental clinicians, more attention can be devoted to making postural improvements since less focus is devoted to learning the basic clinical aspects of the profession.

Although ergonomic interventions may consist of cognitive, physical, and organizational interventions, most studies, including the present study, have only tested the effects of physical interventions.²¹ The main limitation of cognitive and organizational interventions is the lack of translation into postural changes with the individual clinician.²² Dental students failed to demonstrate neutral working postures after receiving cognitive instruction on ergonomics.²³ However, no ergonomic intervention has been shown to overcome a clinical environment that inhibits neutral and ergonomic postures.⁵ Compromised postures arising from challenging work environments, may start to become habitual and difficult to modify over time.⁸

Limitations were identified in this study. The small sample size and the use of single research site limits the generalizability of the results. Future studies should be completed using larger sample sizes and dentists and dental hygienists practicing at different institutions and settings. The use of still-imaged versus video-imaged postures may have introduced bias when the postures were captured. Although the Hawthorne effect may have contributed to the overall improvements in postures, the training intervention led to greater improvements in postures with dentists and dental hygienists as compared to the control group. Future studies should explore longerterm effects of ergonomics training utilizing self-assessment, photography and feedback. Clinicians' confidence in performing ergonomic self-assessments and the benefits of booster ergonomics training sessions should also be explored.

Conclusion

Ergonomics training utilizing photography and feedback resulted in improvements in both ergonomic scores and the accuracy of ergonomic self-assessments among practicing dentists and dental hygienists. All participants strongly agreed that it was important for practicing clinicians to understand and apply proper ergonomics in addition to accurate ergonomic self-assessment skills. Improving ergonomic selfawareness through self-assessment, can help decrease the risks of developing WMSDs among practicing dentists and dental hygienists.

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Innovations in Dental Hygiene Education

Human Papillomavirus Content Inclusion in Dental Hygiene Program Curricula in the United States

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Abstract

Purpose: Human papillomavirus (HPV)-related oropharyngeal cancers (OPC) have significantly increased over the past three decades despite vaccine availability to prevent carcinogenic HPV types. Dental hygienists are well-positioned to provide HPV counsel to patients; however, most do not feel prepared to do so. The purpose of this study was to examine HPV content inclusion in dental hygiene program curricula in the United States (US).

Methods: Dental hygiene program directors in the US were invited to participate in an electronic survey (n=309). The 20item survey assessed the curricular content related to HPV as well as the faculty training in this area. Descriptive statistics were used to analyze the data.

Results: Ninety surveys were returned for a response rate of 29%. Most programs spent up to 2 hours on HPV content. Students across all institutional settings received education on OPC risk factors (66.3%); HPV screening, referral, and management (78.7%); HPV vaccine knowledge (79.8%); and communication skills about HPV (77.5%). The majority of HPV-related content was taught by dental hygiene faculty, although dentists, oral pathologists or medical specialists were involved across all institutional settings.

Conclusion: Results indicate that dental hygiene programs, regardless of institutional setting, provide two hours or less of HPV didactic content and clinical application. More research is needed to confirm the adequate time and teaching strategies required to assure that dental hygienists are well-prepared to address HPV preventive strategies.

Keywords: dental hygienists, dental hygiene education, human papilloma virus, oropharyngeal cancer, patient education

This manuscript supports the NDHRA priority area of **Professional development: Education** (interprofessional education). Submitted for publication: 6/18/20; accepted: 8/15/20

Introduction

Head and neck cancers, including oropharyngeal cancers (OPC), are the sixth most common cancer type worldwide; over the last decade and the human papillomavirus (HPV) has been linked to an estimated 70% of all oropharyngeal malignancies.^{1,2,3} The human papillomavirus is a group of more than 200 related viruses.⁴ Twelve types are considered high-risk as they manifest carcinogenicity in humans.⁴ One in four people in the United States (US) become infected with HPV annually through skin-to-skin, vaginal, anal or oral contact with an infected person.⁴ While no signs or symptoms may be present at the time of infection, a malignancy may develop years after the initial infection.¹ Risk factors for oral HPV-related cancers include individuals who have multiple sexual partners and those who engage in oral sex practices.³ The Centers for Disease

Control and Prevention (CDC) reported that approximately 44,000 people were diagnosed with HPV-related cancers between 2011 and 2015.⁵ While cervical cancer historically accounted for the greatest number of HPV-related cancers with 10,900 cases per year, HPV-associated OPC now account for 13,500 new cases annually.⁵ Incidence among males is nearly five times that of females, with 11,300 and 2,200 annual cases, respectively.⁵

Human papillomavirus infections can be prevented by vaccines that have been shown to be both safe and highly effective.⁶⁻⁸ While vaccine efficacy trials measured the prevention of cervical cancers, the vaccine targets the same virus types associated with HPV-related OPC and these vaccines are expected to also prevent OPC.⁶ While three

vaccines were originally approved by the US Food and Drug Administration in 2006, Gardasil 9[°] (Merck; Kenilworth, NJ, USA) is currently the only vaccine available in the U.S. Gardasil 9[°] provides protection against 9 viral strains, including HPV 16, 18, the strains most often associated with OPC.⁶ Two to three doses are recommended based on the individual's age and risk factors. Following consultation with a health care professional, two doses have been recommended for those between the ages of 9 and 14 years, and threedoses for those between the ages of 15 and 45 years.⁸ Despite vaccine availability, HPV vaccination rates remain low in the US compared to other routine childhood immunizations.⁹ As of 2018, only slightly more than half (51.1%) of adolescents in the US had completed the HPV-vaccine series.⁹

The lack of adherence to current vaccination recommendations may be due to lack of knowledge among the general population.¹⁰ Current public knowledge regarding HPV is largely related to cervical cancer and many people may be unaware of the relationship between HPV and OPC.¹¹ Results from a national survey indicated that only 2% of the US population were able to identify HPV as a sexually transmitted infection and even fewer were aware of the link to OPC, creating intrinsic challenges for clinicians to dedicate additional time needed to provide vaccination education and patient counseling.

In 2016, the CDC reported that the number of people with a dental visit in the past year consisted of 84.6% children, aged 2-17 years; 63.4% adults, aged 18-64 years; and 64.3% adults, aged 65 and over.¹² These data suggest that an opportunity exists to provide HPV-related education to those at greatest risk of HPV infection. Dental hygienists are well-positioned to provide HPV education as part of routine head and neck examinations and oral cancer screenings. This education opportunity includes the identification and discussion of risk factors in addition to early detection and diagnosis in the dental setting.¹³

Recent studies report that dentists and dental hygienists do not feel ready to discuss HPV-related risk factors with patients.¹⁴⁻¹⁸ One study found that most dental providers were not comfortable discussing the topic of HPV risk and transmission in the dental practice setting and that the level of comfort varied based on the patient's age, gender, and relationship to the provider.¹⁷ To overcome this provider discomfort, undergraduate dental hygiene programs should be prepared to assume the responsibility of preparing students with communication strategies regarding HPV infection, including vaccine advocacy. Dental hygiene students who are able to apply and practice these strategies will be better equipped to normalize conversations regarding HPV risk factors in clinical practice.

Currently there are no reports in the literature on how HPV topics are taught in US dental hygiene programs or whether dental hygiene faculty are trained to teach communication strategies related to HPV. The Commission on Dental Accreditation (CODA) Standard 2.24 indicates that dental hygiene programs are required to have an "ongoing curriculum review and evaluation process" with a "defined mechanism for coordinating instruction among dental hygiene faculty."19 The intent of this standard is to ensure that emerging information is periodically incorporated into the curriculum through workshops and in-service sessions, on an as needed basis. As HPV infection, and the ability to prevent disease through vaccination, is an emerging topic and of importance in oral as well as general health, it is important that dental hygiene programs consider the inclusion of curricular elements related to HPV. Furthermore, faculty may also benefit from preparation focused on HPV content in both didactic and clinical settings. The purpose of this study was to determine the extent to which HPV-related topics are taught in undergraduate dental hygiene programs in the US.

Methods

This study was reviewed and deemed exempt by the University of Minnesota (UMN) Institutional Review Board (STUDY00001463). A descriptive, cross-sectional design, consisting of a survey of US dental hygiene program directors and coordinators was used. Potential participants were identified from the American Dental Education Association's Listserv of dental hygiene program director emails as of January 2018 (n=335).

A link to an electronic survey was emailed to potential participants including a description of the study's purpose, the estimated time required to complete the survey and an informed consent option. Study data were collected and managed using the secure Research Electronic Data Capture (REDCap) software application hosted at UMN.²⁰ The survey was available to participants during a six-week period in April - May 2018. Second and third emails were sent automatically to non-responders at two-week intervals following the initial invitation. All responses were anonymous and no identifying information was reported.

The survey was modified from a previously used validated instrument after receiving permission from the authors.^{21,22} The modified survey was pilot tested by six UMN School of Dentistry faculty members (five dental hygienists and one oral pathologist) and minor revisions were made based on the feedback. The 20-item survey included six demographic questions (institutional setting, degrees/credentials offered, average number of graduating students, program length, number of full-time faculty, and patient age groups served). Five items (yes or no responses) inquired about HPV-related curricula; use of HPV risk assessment in clinics, student requirement to discuss patient sexual risk factors or practices, faculty training to teach HPV-related topics, dental hygiene student engagement with other health care professional students, and HPV educational resource availability for patients. Three multiple-choice questions inquired regarding the number of hours spent in classroom instruction on HPV by program type; the estimated total number of hours of HPV didactic and clinical education; and the specific training of faculty responsible for teaching HPV-related OPC topics. Six items were specific to the total number of classroom and clinical hours students received regarding HPV and OPC risk; HPV screening, prevention, referral, infection management; knowledge of the HPV vaccine; skills in communication about HPV and the vaccine; and advocating for HPV vaccination for at-risk patients. Respondents also had the option for open-ended feedback in the last item.

Descriptive statistics reporting counts and proportions were used to analyze the data. SAS V9.3 (SAS Institute; Cary, NC, USA) statistical software was used for the analysis.

Results

A total of 335 dental hygiene program directors and coordinators were invited to participate via email; 26 invitations were either duplicates or undeliverable. Of the unique and valid potential participants, 90 surveys were completed for a response rate of 29%. The majority of respondents were directors at community or junior colleges. Most programs graduated fewer than 25 students annually regardless of institutional setting. The patient population at all program sites was similar across pediatric, adolescent, adult, and geriatric age groups. Dental hygiene program demographics by institutional setting are shown in Table I.

Most respondents reported that HPV was included as part of classroom instruction content regardless of degree type or institutional setting. However, few dental hygiene programs included clinical assessments related to HPV (14.4%, n=90). The majority of programs limited the time spent on HPVrelated topics to two hours or less. Few programs reported that their students engaged with other healthcare students on the topic of HPV, although students attending a college or university with a dental school were most likely to report interprofessional communication related to HPV. Similarly, few programs reported providing patients with HPV-related educational materials with technical/vocational schools and community colleges reporting the highest proportions. HPV- related topics and activities by institutional setting are shown in Table II.

Characteristics of faculty teaching HPV-related topics in dental hygiene programs are shown in Table III. Nearly all instructors teaching HPV-related topics were dental hygiene faculty members (96%). In addition, dentists, oral pathologists or physicians/other medical specialists were also involved in teaching HPV-related topics (46.7%). Dental hygiene programs associated with a dental school were more likely to have an oral pathologist teach HPV content compared to programs without a dental school. Slightly more than onefourth (26%) of faculty responsible for HPV content had completed special training on teaching HPV-related topics.

Discussion

Human papilloma virus-related content in dental hygiene curricula has not been previously reported in the literature. This study has similarities to research conducted by Wilder et al. regarding the introduction of another new topic into the dental hygiene curricula: the relationship between periodontal disease and systemic diseases.²² Similar to the Wilder et al. study, this new curricular content, HPV and OPC, received two hours or less time in the dental hygiene program, while topics such as cardiovascular diseases, diabetes and tobacco use, received between 3 to 5 hours.²²

In this study, dental hygiene programs receiving the most classroom instruction on HPV-related topics were baccalaureate degree programs within a dental school, followed by those without a dental school, and the associate degree programs. Results were grouped by institutional type as baccalaureate degree programs have expanded requirements and require more time for degree completion compared to associate degree programs. Results from this study also confirmed that associate degree programs had fewer fulltime faculty, perhaps increasing the difficulty of assuring a wide breadth of expertise. Curricular content may be more robust in institutions offering baccalaureate degrees. Further, dental hygiene programs offered at universities associated with dental school programs may have access to faculty members with specific expertise in head and neck cancers. This proximity often facilitates engaging resident experts in instructing dental hygiene and other related disciplines.

It is unclear whether providing up to two hours of HPV content results in dental hygiene students who can retain and apply the information upon graduation in clinical practice and additional professional development may be needed. In a study designed to test a web-based education module using a behavioral framework to encourage primary care providers (physicians,

Table I. Dental hygien	e program dem	ographics by in	nstitutional s	setting (n=90).
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	Technical/ Vocational (n=7)	Community/ Junior College (n=54)	College/ University with Dental School (n=8)	College/ University without Dental School (n=21)			
	n (%)	n (%)	n (%)	n (%)			
Degree(s) offered [†]							
Certificate/Diploma	_	_	1 (12.5)	_			
Associate Degree	7 (100)	52 (96.3)	_	7 (33.3)			
BS Completion	_	1(1.9)	5 (62.5)	8 (38.1)			
BS	_	1(1.9)	8 (100)	16 (76.2)			
Graduate Degree	_	_	4 (50.0)	1 (4.76)			
Average of annual gra	iduates						
< 25	4 (57.1)	38 (70.4)	2 (25.0)	7 (33.3)			
25-39	3 (42.9)	16 (29.6)	3 (37.5)	12 (57.1)			
40 or more	_	_	3 (37.5)	2 (9.5)			
Patient age groups se	Patient age groups served (y)						
Pediatric (0-12)	6 (85.7)	50 (92.6)	8 (100)	20 (95.2)			
Adolescent (13-17)	6 (85.7)	52 (96.3)	8 (100)	20 (95.2)			
Adults (18-59)	7 (100)	54 (100)	8 (100)	21 (100)			
Geriatric (60+)	6 (85.7)	52 (96.3)	8 (100)	19 (90.5)			

[†]Respondents indicated one or more-degree type.

physician assistants, and nurse practitioners) to conduct oral cancer examinations on their patients, the majority of participants reported impactful learning for their professional practice and suggested that the 40 minute educational program be broken down into faster paced, 15-minute segments to accommodate busy schedules.²³ While this finding is not directly comparable to teaching in a dental hygiene undergraduate program, these results may be helpful to provide HPV and OPC curricular content for practicing dental hygienists in continuing education settings.

Dental hygiene program directors in this study reported that 96% or more of instructors teaching HPV content were dental hygiene faculty with less than half receiving any training on how to teach HPV topics. Since there is limited evidence on HPV knowledge and training of dental hygiene educators, the available evidence on practicing licensed providers can be considered. Several studies report that few dental hygienists and dentists feel confident with their current HPV knowledge.^{14,15,24} Daley et al. identified knowledge deficits among dentists and dental hygienists, with a majority employed in a private practice setting.¹⁸ In another study, dental hygienists who scored significantly lower on the knowledge scale did not discuss HPV with patients compared to those who scored higher and were able to discuss HPV to some degree.¹⁵ Stull and Lunos found that 66% of respondents in the Minnesota dental community reported discomfort in HPV discussions with patients due to lack of knowledge along with other perceived barriers.¹⁴

Non-dental health care providers also report feelings of inadequacy when counseling patients on HPV-related issues. Afonso et al. examined HPV vaccination rates of millennial medical students (n = 214) and discovered that while 82% of students believed in recommending the HPV vaccine, only 40% felt knowledgeable about

the vaccine and were comfortable counseling patients.²⁵ Overall, health care provider knowledge and comfort level in counseling patients about HPV vaccination appear to be lacking in multiple educational and clinical practice settings.

While research shows that dental hygiene clinicians are not comfortable having HPV discussions with their patients, it is not clear whether these findings apply to dental hygiene educators.^{15,24} Further research is needed to determine whether dental hygiene educators who teach HPV content are more comfortable having discussions with patients about HPV and other sensitive health topics in clinical education settings as compared to clinicians working in other practice settings.

Time constraints in crowded dental hygiene curricula may also affect the extent to which HPV content is represented. Hosking et al. surveyed pediatric dental program directors and found that while 77% of pediatric graduate program directors believe that they should discuss HPV vaccination with patients and parents, only 25% actually incorporate formal training related to HPV in their curriculum due to time constraints.²⁶ However, 92.2% of directors reported a positive interest in showing their residents a 15-20 minute presentation about HPV vaccination and how to communicate with parents.²⁶ Strategies to combine HPV content in dental hygiene communication courses may be a potential resolution to the time limitations within the dental hygiene curriculum.

Results of this study found that patients are not receiving additional educational resources from the dental hygiene clinics where they receive care. Providing accurate information

Table II. HPV-related topics included in undergraduate dental hygiene curricula by institutional setting (n=90).

Survey item		Technical/ Vocational (n = 7)	Community/ Junior College (n = 54)	College/University with Dental School (n = 8)	College/University without Dental School (n = 21)
		n (%)	n (%)	n (%)	n (%)
	Associate	5 (71.4)	44 (81.5)		5 (23.8)
Program receiving the most	Bachelor	_	2 (3.7)	8 (100)	14 (66.7)
HPV classroom instruction	None	2 (28.6)	7 (13.0)	_	2 (9.5)
	Not sure	_	1 (1.9)	_	_
Curriculum includes HPV clinical risk	assessment	1 (14.3)	8 (15.1)	2 (25.0)	2 (9.5)
	Current num	ber of hours spe	ent on HPV-related	d topics	
		(n = 7)	(n = 53)	(n = 8)	(n = 21)
	0	_	1(1.9)	_	_
	< 1 to 2	4 (57.1)	37 (69.8)	4 (50.0)	13 (61.9)
Oral-pharyngeal cancer risk	3 to 5	1 (14.3)	11 (20.8)	4 (50.0)	7 (33.3)
	6 +	_	2 (3.8)	_	1 (4.8)
	Not sure	2 (28.6)	2 (3.8)	_	-
	0	1 (14.3)	7 (13.2)	_	3 (14.3)
	< 1 to 2	4 (57.1)	35 (66.0)	7 (87.5)	16 (76.2)
HPV screening, prevention, referral	3 to 5	_	5 (9.4)	1 (12.5)	2 (9.5)
& infection management	6 +	_	2 (3.8)	_	_
	Not sure	2 (28.6)	4 (7.6)	_	_
	0	_	6 (11.3)	_	_
	< 1 to 2	5 (71.4)	40 (75.5)	7 (87.5)	19 (90.5)
	3 to 5	_	5 (9.4)	1 (12.5)	2 (9.5)
HPV vaccine	6 +				
	Not sure	1 (14.3)	2 (3.8)	_	_
	N/A	1 (14.3)	_	_	-
	0	1 (14.3)	10 (18.9)	1 (12.5)	4 (19.1)
	< 1 to 2	3 (42.9)	31 (58.5)	5 (62.5)	14 (66.7)
Communication skills with patients	3 to 5	1 (14.3)	7 (13.2)	1 (12.5)	2 (9.5)
about HPV	6 +	_	_	1 (12.5)	1 (4.8)
	Not sure	1 (14.3)	5 (9.4)	_	_
	N/A	1 (14.3)	_	_	_
	0	1 (14.9)	16 (30.2)	2 (25.0)	6 (28.6)
	< 1 to 2	4 (57.1)	26 (49.1)	5 (62.5)	13 (61.9)
Communication skills about	3 to 5	_	4 (7.6)	1 (12.5)	2 (9.5)
	6 +	1 (14.3)	6 (11.3)	_	_
	Not sure	1 (14.3)	1 (1.9)	_	_
	0	2 (28.6)	18 (34.0)	1 (12.5)	6 (28.6)
	< 1 to 2	3 (42.9)	25 (47.2)	6 (75.0)	13 (61.9)
Advocating for HPV vaccination	3 to 5	-	4 (7.6)	1 (12.5)	1 (4.8)
among at-risk patients	6 +	-	_	_	1 (4.8)
	Not sure	1 (14.3)	5 (9.4)	_	_
	N/A	1 (14.3)	1 (1.9)	-	-

Survey item	Technical/ Vocational (n = 7)	Community/ Junior College (n = 54)	College/University with Dental School (n = 8)	College/University without Dental School (n = 21)
	n (%)	n (%)	n (%)	n (%)
Dental hygiene students engage with other healthcare students on the topic of HPV	1 (14.3)	7 (13.2)	2 (25.0)	3 (14.3)
HPV-related educational materials available to patients	2 (28.6)	9 (17.0)	1 (12.5)	5 (23.8)

Table II. HPV-related topics included in undergraduate dental hygiene curricula by institutional setting (continued).

Table III. Characteristics of faculty teaching HPV-related topics in dental hygiene programs (n=90).

Survey Questions	Technical/ Vocational n = 7	Community/ Junior College n = 54	College/ University with Dental School n = 8	College/ University without Dental School n = 21		
	n (%)	n (%)	n (%)	n (%)		
Full time faculty						
<5	4 (57.1)	41 (75.9)	2 (25.0)	7 (33.3)		
5 - 10	2 (28.6)	13 (24.1)	4 (50.0)	12 (57.1)		
11 - 15	1 (14.3)	_	2 (25.0)	2 (9.5)		
Faculty teaching	Faculty teaching HPV-related cancer topics					
Dental hygiene faculty	7 (100)	51 (94.4)	8 (100)	20 (95.2)		
Dentist faculty	2 (28.6)	19 (35.2)	3 (37.5)	5 (23.8)		
Oral pathologist	1 (14.3)	3 (5.6)	7 (87.5)	1 (4.8)		
Physician/other medical specialist	_	1 (1.9)	_	_		
Faculty are trained how to teach HPV- related topics	1 (14.3)	12 (22.6)	3 (37.5)	7 (33.3)		

to patients is critical to disrupt disease transmission, particularly to those at high risk of contracting HPV.^{27,28} The dental community provides early head and neck cancer detection through routine screenings, and patients report that their most trusted source of oral health information is from their dental providers.¹³ Lazalde et al. reported that while parents are most comfortable with their child's primary care provider administering HPV vaccines, they reported high levels of comfort with dentists in other prevention roles, such as providing information about HPV vaccination or talking about HPV risk, suggesting that the dental office is an alternative practice setting suitable for participating in the delivery of education.²⁹ Several organizations including the American Dental Association and the Centers for Disease Control and Prevention have developed HPV educational materials for oral health providers to deliver to patients in dental practice settings. Providers also can review and recommend emerging HPV information available through mobile apps, social media messages, videos, podcasts, fact sheets, brochures, and question and answer guides.

This study had limitations. While the sampling strategy included all dental hygiene program directors, the response rate was lower than desired. The low response rate may be due to lack of time or survey fatigue, as the ease of sending electronic surveys has increased the numbers of surveys distributed and requests are often ignored by recipients.30 Program directors focused on administration as compared to teaching, may not have accurate information regarding the exact amount of time spent, faculty training completed, or patient education provided specific to HPV. Further, while the survey instrument had been used previously, it was adapted for use in this study and the modifications were not validated. The cross-sectional design also limits the generalization of the results.

Future research should focus on the impact of effective HPV communication, educational materials, and evaluation protocols for clinicians. Interprofessional collaborative efforts should be developed during dental hygiene education to improve HPV and OPC education and HPV vaccination efforts. Ongoing faculty development in HPV education should be supported as well as the role of HPV focused continuing education courses.

Conclusion

Results of this study indicate that dental hygiene programs, regardless

of institutional setting, currently provide minimal didactic content and clinical application specific to HPV topics. Dental hygiene faculty teach HPV content in most DH programs, and few clinical teaching facilities provide HPV educational content to patients. More research is needed to understand the adequate time and teaching strategies required to assure that dental hygiene students are well-equipped to address HPV preventive strategies in clinical practice.

Disclosure

This study was funded in part by the University of Minnesota, School of Dentistry, Division of Dental Hygiene.

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Innovations in Dental Hygiene Education

Legislative Advocacy: Undergraduate and Graduate Student Learning Outcomes

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Abstract

Purpose: Legislative advocacy provides an avenue through which oral health disparities and alternative methods of delivering oral health care to underserved populations can be addressed. The purpose of this study was to assess advocacy knowledge, values, actions and perceived barriers of undergraduate and graduate students enrolled in a leadership course with a Legislative Advocacy Project (LAP).

Methods: A pre-test/post-test online questionnaire was administered to a convenience sample of undergraduate and graduate dental hygiene students to measure advocacy knowledge, values, and actions resulting from participation in a LAP (n=38). Descriptive statistics assessed the average responses of perceived barriers. Two open-ended questions asked about participation in advocacy and providing feedback regarding the LAP.

Results: Both groups (undergraduate, n=25; graduate, n=13) demonstrated a statistically significant change from the pre-test/ post-test assessment of knowledge, values, and actions (p<0.001). No statistically significant differences were identified when comparing undergraduate and graduate level responses, pre-test and post-test scores and undergraduate and graduate level responses, and perceived barriers. The three greatest barriers were lack of time to participate in legislative activities, lack of comfort speaking to legislators and testifying before legislators. Responses to the open-ended questions suggested learning in the three lower levels of the affective domain.

Conclusion: Knowledge, values, and actions were increased following the LAP. Strategies to address ongoing barriers should be implemented in advocacy curricula. The LAP was influential in integrating cognitive knowledge and changing receiving, responding, and valuing levels of the affective domain. An Affective Advocacy Model was developed based on the analysis of responses to the open-ended questions and current literature.

Keywords: dental hygiene students, dental hygiene education, advocacy, legislation, leadership, learning domains

This manuscript supports the NDHRA priority area, **Professional Development: Education** (Educational models).

Submitted for publication: 3/15/20; accepted: 7/30/20

Introduction

Legislative advocacy provides an avenue through which oral health disparities and alternative methods of delivering oral health care to underserved populations can be addressed. Experiences in advocacy for dental hygiene students offers a pathway for the promotion of oral health in all populations. A seven-week Legislative Advocacy Project (LAP), that involved assessment, planning, implementation, and evaluation, was incorporated into the curriculum for undergraduate and graduate dental hygiene students.¹ This LAP encouraged students to enhance knowledge about advocacy, value the process of advocacy, and encourage behavior changes about advocacy actions. During the assessment stage of the LAP students learned about the legislative efforts of the state's dental hygiene professional association, the role of the state association lobbyist, the state legislative system, and legislators as policy decision-makers. Also, student's chose a health bill to follow through the legislative process and identified potential collaborators and opponents to this legislation. During the planning stage students developed a strategic plan to contact legislators in support or opposition of the bill. The implementation phase involved contacting the legislator while following the bill through the legislative process. In the evaluation stage the strategic plan outcomes and effectiveness of the LAP were assessed.¹ Education for students in the oral health professions includes the three domains of learning: cognitive, affective, and psychomotor. The LAP objectives were designed to guide the process of this educational unit and focused on the cognitive domain of learning. Cognitive learning is an important context in classroom instruction whether it be face-to-face or in an online learning format. The original 1956 cognitive taxonomy developed by Bloom and associates was revised by Anderson and associates in 2001.² The revision reflects a hierarchy of verbs rather than a hierarchy of nouns as in the original version emphasizing that learning is an action.^{2,3} The hierarchy of actions include, beginning with the lowest level: remembering, understanding, applying, analyzing, evaluating, and creating.³

As well as providing cognitive acquisition of knowledge, education in oral health programs addresses values, beliefs, and attitudes that are within the affective domain.⁴ Affective learning is also a hierarchical process where the lowest level, receiving, is followed by responding, valuing, organization, and characterization (Figure 1).⁴ This type of learning is complicated to assess in the educational setting because it integrates cognitive knowledge, feelings, and behavioral changes.⁵ Affective learning requires a form of transformational experiences to create self-exploration and a change in one's values.^{6,7} Having learners engage in characterization, the highest level of this domain, represents action and change in behavior based on the learners' newly formed value system.

Figure 1. Affective Domain



Previous research demonstrated an increase in dental hygiene students' knowledge, values, and actions after participating in the LAP.⁸ Anecdotal responses from participants reflected learning at the lower levels of the affective domain: receiving, responding, and valuing. Participant responses indicated increased political awareness, increased personal efficacy, and valuing one's voice.⁸

Another investigation regarding the advocacy actions of dental hygiene alumni who had completed the LAP during their graduate and undergraduate education was also conducted.⁹ Results showed a significant difference for participation in legislative efforts prior to and after the LAP; however, the implementation of advocacy actions was challenging due to competing barriers. Participants reflected a strong desire to engage in advocacy actions demonstrating "valuing" in the affective domain. Participants acknowledged experiences with underserved populations, the impact on one's career, or importance of an issue to dental hygiene. Importance and passion were identified as key triggers to engaging in advocacy action.⁹

A third study about advocacy actions of dental hygiene practitioners engaged in improving access to care was conducted.¹⁰ Improvements to oral health equity

were addressed through three key elements: 1) learning and educating, 2) critical awareness and empowerment, and 3) individual and collective action. The interaction within and among these components generated the energy to fuel the momentum needed to sustain the social action to improve oral health. The learning and educating element of this theory, Synergy in Social Action, is within the cognitive domain while critical awareness and empowerment represent the affective domain.¹⁰ This awareness and empowerment fuels individual and collective action. Study participants organized and prioritized a new value system based on experiences and advocacy for disparate populations that resulted in advocacy actions on a regular basis.¹⁰

Each of these research studies suggested that learning in the cognitive and affective domains occurred either through a planned curriculum or as a result of practitioner experiences to create awareness. Affective learning, resulting in awareness was created and current value systems were examined and reorganized into new value systems to guide advocacy actions. The purpose of this descriptive comparative study was to evaluate the knowledge, values, and actions before and after the LAP and the perceived barriers to participation in advocacy efforts.

Methods

This study was granted exempt status by the Idaho State University (ISU) Institutional Review Board. Dental hygiene students from the ISU Bachelor of Science and Master of Science degree programs were the convenience sample for the study. A questionnaire was administered to undergraduate level students (n=25) and graduate level students (n=13) who were completing a seven-week LAP in a leadership course offered during the spring of 2014. Undergraduate students completed the course via real-time classroom instruction in small groups of 3-4 students. Graduate students completed the project individually in an asynchronous online course.

The pre-test included demographic items, and assessed legislative advocacy knowledge, values, and actions. The post-test included the same knowledge, values and actions items as well as perceived barriers to future advocacy actions. It also included two open ended questions addressing participation in advocacy efforts and providing feedback about the LAP. The knowledge variable and the barriers were assessed on a seven-point Likert scale ranging from 1=strongly disagree, to 4=neutral and 7=strongly agree. The degree of importance for the values variable was scored with a seven-point Likert scale ranging from 1=extremely not important, to 4=neutral and 7=extremely important. The action variable was assessed on a seven-point Likert scale measuring probability of engaging in actions ranging from 1=not very probable, to 4=neutral and 7=very probable. The questionnaire's Item Content Validity was previously established at 80% or higher.8

The questionnaire was administered via Qualtrics (Provo, UT) for three weeks for both the pre-test at the beginning of the course and the post-test at the end of the course. Two reminder emails were sent for the pre-test and the post-test. Participants were offered an incentive of one bonus point added to their final grade if all questions on the pre-test and post-test were completed. Students were also given the choice not to participate in the study and complete an alternative activity to earn the bonus point.

Chronbach's alpha scores were calculated for each of the pre-test and post-test knowledge, values, and actions variables. Hypothesis testing occurred through parametric analysis with a RM-ANOVA to compare averages from pretest to posttest responses and between the undergraduate and graduate groups. Assumptions of normality were investigated by using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Homoscedasticity assumptions were assessed with the Box's M test of equality of variance matrices and Levene's Test of equality of error variance. If either assumption of normality or homoscedasticity were violated, non-parametric testing was employed to define the robustness of the RM-ANOVA.

Descriptive statistics determined the average responses of perceived barriers to legislative advocacy (mean and standard error). Mann-Whitney U testing compared differences between undergraduate and graduate responses to perceived barriers. Bonferroni corrected *p*-values minimized the occurrence of a Type I error. Statistically significant results of *p*≤0.05 were reported. All comments from the two openended questions were coded and grouped according to the hierarchy of the affective taxonomy of learning.⁴

Results

One hundred percent of the convenience sample responded (undergraduate; n=25 and graduate; n=13). All participants were female and undergraduates were between the ages of 20 and 30 years while the majority of the graduates were between the ages of 30 and 40 plus years. All undergraduate students were members of the American Dental Hygienists' Association (ADHA) Student Dental Hygienists' Association and 18.5% (n=5) served in leadership positions in this organization. Approximately one-half of the graduate participants held membership in the ADHA (46%; n=6), and 15.5% (n=2) served in leadership positions. In both groups, 83% (n=34) were registered to vote and 68% (n=28) voted in the last election.

Cronbach's alpha scores of 80% or higher were established for each of the three variables for both pre-test and post-test responses to measure the consistency of the scales in the questionnaire. The pre-test knowledge score was 0.872 and the post-test was 0.804. The pre-test value score was 0.991 and the post-test was 0.941. The pretest action score was 0.920 with a post-test of 0.953. These scores indicated a high internal consistency of the variables.

Descriptive statistics suggested an increase in mean scores for both the undergraduate and graduate level participants from pre-test to post-test (Table I). Both levels of students ranked pre-knowledge scores as almost neutral, while high post knowledge scores were reported. Pre-value and post-value scores were high for both groups. Pre-actions were ranked neutral to high for all participants while post actions were ranked higher.

Table 1. Pretest and Posttest Mean Scores and Standard Errors*				
	Undergraduate Level	Graduate Level		

	Undergrad	luate Level	Graduate Level		
Variable Pre-test Post- Mean (SE) Mean		Post-test Mean (SE)	Pre-test Mean (SE)	Post-test Mean (SE)	
Knowledge	3.5 (0.20)	6.5 (0.09)	4.1 (0.29)	6.5 (0.09)	
Values	6.0 (0.15)	6.6 (0.12)	6.4 (0.21)	6.8 (0.16)	
Actions	3.9 (0.25)	4.7 (0.27)	4.7 (0.33)	5.3 (0.36)	

*Scores ranged from 1 (lowest) to 7 (highest).

No violations to the homoscedasticity were present for the knowledge, values, and actions scales; however, normality was violated with the values and actions outcomes. The nonparametric testing, used to verify the robustness of the RM-ANOVA when violations to normality was present, did not differ from the RM-ANOVA; therefore, parametric results were reported for all three variables.

There was a significant difference in knowledge from pre-test to post-test for all participants (p < 0.001) (Table II). When comparing undergraduate and graduate level participants knowledge, no significant difference was found between the groups (p=0.141). No significant interaction was detected between the pretest versus posttest knowledge scores and undergraduate versus graduate level (p=0.072).

Similarly, for the values variable, a significant difference for the under-graduate and graduate level participants, pre-test to post-test, was found (p<0.001) (Table II). No significant differences were found when comparing undergraduate to graduate level (p=0.243) and no significant interaction was detected when comparing the pre-test versus post-test scores and undergraduate versus graduate level (p=0.389).

The results for the actions variable found a significant difference between the pretest and posttest scores (p < 0.001) (Table II). No significance difference was detected when comparing the two groups (p=0.184) and no significant interaction was demonstrated when comparing the pre-test versus post-test and the undergraduate versus graduate level (p=0.922).

No significant differences were found between the undergraduate and graduate responses about perceived barriers (p=0.119). The three greatest barriers were: lack of time to be involved in legislative activities, lack of comfort speaking personally with legislators or staff members, and lack of comfort testifying before legislators (Table III). Representative comments to the two

Table II. Knowledge,	values, actions	RM-ANOVA with	Bonferroni correction

Knowledge					
Source	SS	df	MS	F	Sig
Pre-test vs Post-test Undergraduate and Graduate	110.802	1	110.802	243.108	<i>p</i> <0.001*
Undergraduate vs Graduate	1.579	1	1.579	2.276	<i>p</i> =0.141
Pre-test vs. Post-test and Undergraduate vs. Graduate	1.579	1	1.579	3.465	<i>p</i> =0.072
	Va	lues			
Source	SS	df	MS	F	Sig
Pre-test vs Post-test Undergraduate and Graduate	3.748	1	3.748	22.940	<i>p</i> <0.001*
Undergraduate vs. Graduate	1.011	1	1.011	1.411	<i>p</i> =0.243
Pre-test vs. Post-test and Undergraduate vs. Graduate	0.124	1	0.124	0.762	p=0.389
	Ac	tions			
Source	SS	df	MS	F	Sig
Pre-test vs. Post-test Undergraduate and Graduate	10.597	1	10.957	25.510	<i>p</i> <0.001*
Undergraduate vs. Graduate	4.986	1	4.986	1.836	<i>p</i> =0.184
Pre-test vs. Post-test and Undergraduate vs. Graduate	0.004	1	0.004	0.010	<i>p</i> =0.922

* Statistical Significance: p=0.05

Table III. Perceived barrier scores

Barrier	Undergraduate Level Mean (SE)*	Graduate Level Mean (SE)
Lack of time to be involved	5.58 (0.22)	6.23 (0.20)
Lack of comfort speaking personally with legislators or staff members	5.04 (0.30)	4.23 (0.57)
Lack of comfort testifying before legislators	4.72 (0.33)	4.85 (0.50)
Lack of priority to be involved	4.54 (0.36)	3.38 (0.50)
Lack of mentorship in the state dental hygienists' association	3.81 (0.31)	3.08 (0.49)
Lack of interest advocating	3.69 (0.36)	2.31 (0.23)
Lack of belief that my legislative actions can make a difference	3.56 (0.33)	2.54 (0.48)
Lack of knowledge of the legislative process	2.33 (0.32)	1.69 (0.17)

* Standard Errors

open-ended questions are reported in Table IV. Participant comments reflected the first three levels of affective learning: receiving, responding, and valuing.

Table IV. Exam	ples of Resp	onses to Op	pen-Ended (Juestions
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Affective Domain	Encourage probability of participating in legislative advocacy to improve oral health. Additional feedback about the LAP
Receiving	This educational project helped me gain interest in legislation. It helped me to once again realize each role the dental hygienist plays.
Responding	Personal confidence that I can be involved in making a difference. If a bill directly affected me and my family, I would be more willing to be an advocate.
Valuing	I appreciate having the opportunity to learn more about legislation so I am able to put my own voice out to benefit myself and patients. I feel empowered that I can make a change in my community.

Discussion

Completion of a seven-week Legislative Advocacy Project increased knowledge, values, and future actions for undergraduate and graduate participants. Knowledge is represented as learning in the cognitive domain; whereas, values and actions are represented as learning in the affective domain. Both domains are integral to one another; however, it is not clear from this investigation how influential each domain is to the other and further investigation into this relationship is warranted. Real and perceived barriers to advocacy action were identified and educators should provide opportunities in the curriculum to address these barriers. Knowledge about advocacy is not difficult to teach; although, providing meaningful learning experiences to solidify cognition and to influence affective learning requires both time and an investment from administrators, educators and students to develop in professional programs.

Time and investment in advocacy education throughout the professional curriculum and during student professional association activities are needed for students to participate in multiple applications of advocacy. This education should include meaningful experiences such as visiting the state capitol for a tour, participating in a Lobby or Advocacy Day, viewing a legislative session, providing testimony for a health bill or engaging in a mock legislative session with state legislators.⁸ Also, having a state legislator visit students in person or via electronic media allows students to interact and become comfortable with legislators. One example of multiple advocacy experiences involved an Oral Health Policy Forum for dental students to learn about the political environment and the legislative process through interaction with political speakers, small group discussions, presentations by lobbyists, and state legislature visitations during the annual session.¹¹

Advocacy education is currently not included in the accreditation standards for dental hygiene,12 dentistry,13 and dental therapy¹⁴ programs; whereas advocacy standards exist for pediatric dentistry programs.¹⁵ In comparison, the professional associations for oral health care providers have advocacy initiatives and statements within their strategic plans and policies.¹⁶⁻¹⁸ Other health care disciplines have implemented advocacy education into professional curricula. Advocacy is an essential role in professional nursing practice as outlined by statements about ethics, policies, and standards; therefore, teaching nursing students to advocate is imperative.^{19,20} Suggestions for advocacy education from nursing literature include the use of digital storytelling and narrative pedagogy. Digital storytelling involves developing a short media production using photographs, video footage, music, and sound to present an idea or issue, which was related to public health advocacy.²⁰ Narrative pedagogy is teaching and learning that evolves from discussing the lived (advocacy) experiences of teachers, clinicians, and students.²¹

An example of advocacy in medical education, focuses on a three-tiered approach at the individual, community, and legislative level.²² Pediatric residents attended workshops throughout a 9-month curriculum addressing social determinants of health, community resources for patients, and legislative advocacy. The curriculum cumulated with a Lobby Day where the residents learned about federal and state policies affecting pediatric patients and met with state representatives to advocate for disparity issues experienced in the populations they served.²² Pediatric residents significantly improved individual patient advocacy; however further study regarding enhancing community and legislative advocacy is still needed.²² These examples provide suggestions for building designed advocacy experiences into the curriculum to enhance knowledge, values, and actions as well as cognitive and affective learning.

This study was a close replication of previous advocacy study by Rogo et al.⁸ Results of both studies were similar demonstrating that participants' knowledge, values, and actions did improve after participating in a LAP. A difference was found, however; in the current study because there was no significant difference between groups (undergraduate vs. graduate students) when comparing the LAP pre-test to the post-test for all three variables. Results from the current study suggest that the undergraduate and graduate student groups may have had equal stakes in their involvement in the project. One difference in this study as compared to the initial study was that the undergraduate student group sizes were smaller, thereby, increasing active student engagement.⁸ These results indicate that the project is a valuable asset in creating advocacy awareness in dental hygiene curricula.^{8,9}

The top three perceived barriers to advocacy, lack of time, lack of interest and discomfort with public speaking, were the same for both studies.⁸ Vishnevetsky et al. also noted similar barriers when pediatric dentists were surveyed: lack of time, lack of interest in advocacy beyond the dental office, and lack of comfort with public speaking.²³ Negotiating barriers, regardless whether they are perceived or actual, becomes a key strategy in helping students and professionals achieve advocacy action. Alternative active learning strategies to address barrier negotiation might be useful. A Strategic Weakness Opportunity Threat (SWOT) analysis for perceived barriers should aid the professional and professional organizations.²⁴ Also, an Appreciative Inquiry approach could be used to explore strategies that were successful in the past and alternative solutions that focus on a positive tactic rather than on the problem or barrier.²⁵

An Affective Advocacy Model was created based on the analysis of the responses to the open-ended questions and on current literature (Figure 2). The analysis of the participants' responses revealed that some participants' learning from the LAP reached the first three levels of the affective domain: receiving, responding and valuing. Similar results were found in a previous study.⁸ At the receiving level, respondents became aware of the dental hygienists' role in advocacy and were open to LAP experiences. At the second level, responding, students built on their awareness, reacted to the weekly advocacy activities and were motivated to learn. At the valuing level, participants demonstrated appreciation and motivation to invest in and commit to advocacy.

Advocacy commitment was described by dental hygiene alumni as the "importance and passion that bind one to the act of engaging in an advocacy course of action."⁹ Importance was defined as something having value or significance to someone and

Career Experiences ΙΑΡ **CHARACTERIZATION** Engaging in advocacy actions based on a ORGANIZATION new value system. Prioritizing values and VALUING incorporating new values into an old Demonstrating value systems to a belief that RESPONDING create a new one. advocacy actions Participating in LAP RECEIVING Accept ethical are worthwhile activities in small obligations to Developing the and committing to group sharing. engage in advocate for awareness of advocacy. disparate populations the impact of and profession. legislative advocacy on health of pupulations and on dental hygiene.

Figure 2. Affective Advocacy Model

passion was identified as an intense emotion that directed action to create a change.9 A self-reflection paper on the LAP project or other aspects of advocacy is one suggestion to help students recognize and examine core values. A future exploration into transformational learning, the process of developing new schemas based on the reflective assessment of assumptions and demonstration of actions consistent with the new value system,6,26 would also be warranted. Career experiences from working on legislative initiatives to expand practice acts and provide care with new workforce models to ultimately improve access to care has been shown to influence dental hygiene practitioners' affective learning.¹⁰ These experiential activities have been shown to foster affective development at all five levels; however, at the organization level, empowerment was reached when values were prioritized, and perspectives were transformed. At characterization, the highest level, dental hygienists demonstrated engagement in actions and behaviors to improve access to care.10

Gallagher and Little studied physicians' values and advocacy actions.²⁷ Their research suggested that personal values developed from prior life experiences, exposure to situations of empowerment and disempowerment, and the enjoyment of collaboration on advocacy teams with others who shared the same values, contributed to advocacy action.²⁷ Collective efforts and mentoring experiences are key components for experiencing advocacy empowerment which is defined as the "confidence and conviction to engage in advocacy to create change."9 A Professional Development Plan can be used to set goals and develop action items to help students and professionals engage in advocacy action.²⁸ Creating exposure to disorienting dilemmas through planned learning activities or service opportunities in curricula provide an avenue for redefining values and creating a new value system; thus, creating a transformative experience.²⁹

A disorienting dilemma may influence learners to progress from one level of the affective domain to the next. This type of dilemma causes learners to change their perspective through an episodic experience or an accumulation of experiences.⁶ Future research should investigate this phenomenon as learners move through the levels of the affective domain.

Limitations of this study include the small convenience sample from one university. Additional research is needed with larger populations in varying geographic locations to determine the impact of a LAP on learners' knowledge, values, and actions and affective learning in advocacy education. Further investigations are warranted in the area of generating importance and passion leading to legislative action in the affective domain.⁹ Transformative learning in advocacy education merits exploration as well.

Conclusion

An increase in knowledge, values, and actions was achieved after participation in a LAP for undergraduate and graduate dental hygiene students. Barriers will always be present in any advocacy effort; therefore, strategies to address barriers should be included in advocacy education. The LAP implemented in this study created a cognitive foundation for learning about legislative advocacy and generated learning in the affective domain. The LAP was influential in integrating cognitive knowledge and changes in receiving, responding, and valuing, representing the lower three levels of the affective domain. Additional research is needed to examine advocacy education to create transformative experiences leading to characterization, the top level of the affective domain.

Acknowledgements

The authors wish to acknowledge Teri Petersen, EdD, Clinical Assistant Professor of Management, College of Business, Idaho State University, for her expert statistical analysis.

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Innovations in Dental Hygiene Education

Evaluating the Prevalence of Musculoskeletal Neck Pain in Dental Hygiene Students

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Abstract

Purpose: Poor ergonomics is one of the leading factors in developing musculoskeletal disorders. The purpose of this study was to evaluate the level of forward neck flexion of dental hygiene students during manual scaling procedures while wearing magnification loupes and investigate the prevalence of musculoskeletal neck pain.

Methods: A convenience sample of second year dental hygiene students was recruited for this observational study (n=24). A goniometer application was used to measure levels of neck flexion, while wearing dental loupes, 30 minutes into a manual scaling procedure. Participants completed a McGill Pain Questionnaire with a body diagram and an additional survey at the end of the session. Descriptive statistics were used to analyze the data.

Results: All participants' showed neck flexion exceeding 20° at the conclusion of a 30-minute manual scaling procedure. A majority (67%) were in a compromised range and 33% were in a harmful range. The top five pain descriptors identified in the pain questionnaire were aching, tiring-exhausted, throbbing, tender, and heavy. Pain was identified in the shoulder/trapezius (63%), cervical (50%), scapular (36%); and the participants' reported pain ranging from 1 to 7.

Conclusion: Fifty percent of the participants experienced cervical neck pain when exceeding a forward neck flexion of more than 20° during a manual scaling procedure. The shoulder/trapezius and cervical regions were most frequently identified as the location of pain or problems. An early prevalence of musculoskeletal pain in was observed in this sample population of dental hygiene students.

Keywords: dental hygiene students, musculoskeletal disorders, ergonomics, neck flexion, clinical education, magnification loupes

This manuscript supports the NDHRA research agenda **Professional development: Occupational health** (Determination and assessment of risks).

Submitted for publication: 3/1/20; accepted: 9/11/20

Introduction

Musculoskeletal disorders (MSDs) are important occupational health issues in health care workers;¹ and poor ergonomics has been identified as one of the leading factors in developing a MSD.² Musculoskeletal disorders are identified as injuries to the human body support system such as the ligaments, tendons, muscles, nerves, blood vessels, bones, and joints.^{1,3} The goal of ergonomics is to develop a safe and comfortable working environment preventing health problems and improving productivity.^{4,5} Many research studies have documented increased occupational risks for dental hygienists, and dental professionals in general, to develop MSDs.^{1,2,3} A high prevalence rate of work related musculoskeletal disorders in dental professionals has been reported, ranging from 64%-93%.³ Poor ergonomics such as excessive neck flexion, constrained working postures, excessive static and peak loading of the upper trapezius and the forearm extensor muscles all play a role in developing a work-related MSD.² The physical demands for the upper extremities, in addition to limited working fields, unique movements, fine and repetitive tasks, and static postures in dental hygiene practice create an increased risk for dental hygienists to develop work-related MSDs in the neck and shoulders.^{2,6,7} Increased prevalence of work-related MSDs over time has been considered a leading factor in early retirement and career changes among dental professionals.^{2,3,8} Symptoms of work-related MSDs involve swelling, tenderness, numbness, tingling, and loss of strength and pain is reported in the back, neck, hand, wrist, shoulders, as well as lower extremities such as hips, thighs, and knees.^{1,6,9} Musculoskeletal discomfort can be described as slight and recurrent ranging to severe and incapacitating.⁹ Severe pain is often a result of cumulative trauma to effected areas.^{1,3} In a twelve-month study measuring the physical work load among dental hygienists (n=51), a majority (82%, n=42) reported pain in the neck region with one-third of those with neck pain diagnosed with tension neck syndrome.¹⁰

Tension neck syndrome is a separate diagnosis rising from risk factors of work-related MSDs such as sustained exertion, static and awkward postures, and excessive neck bending. Tension neck syndrome involves painful neck spasms and trigger points that come from a specific type of work loading common in dental hygiene.¹¹ Work loading can be explained as the amount of stress put on the muscles during a specific task.¹² Symptoms also include stiffness and limited movement around the neck, pain radiating to the arms and shoulder blades, and a palpable hardness in the neck region.¹³ In a study of the biomechanical demands of manual scaling on the shoulders and neck of dental hygienists, researchers found the neck and shoulders had excessive demands during 30 minutes of manual scaling from the 8 o'clock position.² The participants spent at least 90% of their scaling time over the recommended limits of neck flexion.² Studies continually identify the neck region to be heavily affected by pain among dental professionals.

Magnification loupes have been identified in the literature as a protective factor against MSDs.^{3,14} Dental loupes are beneficial to the clinician in magnifying the work area and reducing muscle strain when fitted correctly, however poorly fitted loupes can contribute to ergonomic strain.¹⁴ Working distance, declination angle, and frame size must be considered for correct fit. An optimal working distance should be 14-20 inches but may vary depending on the operator's size.^{13,15} The declination angle should be steep enough to allow clarity into the working field without excessive neck flexion. Frame size impacts the position of the microscope lenses and declination angle with larger frames resulting in more optimal declination.¹⁵

While work-related-MSDs have been studied extensively in practicing clinicians, including dental hygienists, fewer studies have been conducted among dental hygiene students.¹ Despite the limited number of studies among dental hygiene students, existing research has demonstrated that over a threeyear period, dental hygiene students demonstrated increased neck pain specifically.⁶ Healthy neck flexion has been identified in previous research to be less than or equal to 20 degrees.^{15,16,17,18} Dental hygiene students need to understand the importance of healthy degrees of neck flexion to prevent neck pain, increase productivity and future career longevity. The purpose of this study was to evaluate the level of forward neck flexion of dental hygiene students during manual scaling procedures while wearing magnification loupes and investigate the prevalence of musculoskeletal neck pain.

Methods

Sample

This observational study was approved by the University of New Mexico's Institutional Review Board (ID 18-785). A convenience sample of second-year students from the dental hygiene program at the University of New Mexico were invited to participate in the study (n=24). Participants needed to be over the age of 18, and in the final semester of their second year to be eligible for inclusion in the study population. Informed consent was obtained from all participants.

Instruments

A goniometer iPhone 8plus application (G-pro; 5fuf5, Nobby Beach, AU) was used to measure levels of neck flexion. The goniometer application uses a built-in accelerometer sensor and digital display to measure angles. All measurements taken were performed on the right side of the face once the correct phone axis was established. The criteria for the evaluation assessment of neck flexion were based on Branson et al. Posture Assessment Instrument (PAI).¹⁸ Categories included a healthy range $\leq 20^{\circ}$, a compromised range between $>20^{\circ}$ and $\leq 45^{\circ}$, and a harmful range of $>45^{\circ}$ of neck flexion.¹⁸

A Short Form McGill Pain questionnaire and an additional two question survey was administered at conclusion of the measurement session. The pain questionnaire¹⁹ included a full body pain diagram to indicate the location of pain or problems and columns to indicate the level of pain (mild, moderate or severe) for fifteen pain associated words. Pain was also rated on a linear scale with a range of no pain to the worst possible pain. Pain scales were also ranked from 0-10 in consistent intervals with the pain inventory of no pain to the worst possible pain on the completed questionnaires.

The two-item, yes/no survey asked: "Do you wear dental loupes when performing manual scaling during patient care?" and "Have you had an injury to your head, shoulders, or neck regions prior to dental hygiene school?"

Procedure

A data collection calibration trial on consenting occupational therapy (OT) student volunteers was conducted to test the principal investigator's (PI) reliability using the goniometer application to measure neck flexion. An OT faculty member supervised the PI during the trial sessions. Measurements with a standard goniometer were used to assess agreement. An agreement of plus or minus 5° for goniometry measurements has been deemed acceptable in previous research.²⁰ A total of 50 trials were conducted on OT student volunteers over two days and a 90% (9/10) agreement was found with the two types of measurements by the end of the second day.

Data collection sessions were scheduled over a period of five weeks and took place in one of the dental hygiene clinical operatories. Participants wore their own magnification loupes and performed a manual scaling procedures for 30 minutes. At the conclusion of the 30 minutes of scaling, the level of neck flexion was measured by tapping the iPhone screen while using the gonimeter application. The iPhone was placed at the external auditory meatus, test position parallel or 0°. The axis was adjusted to the test position and aligned with the commissure of the lip to gather the measurement (Figure 1). At the conclusion of session participants were given a hard copy of a short form McGill Pain Questionnaire¹⁸ and the two-item survey.

Figure 1. Neck flexion measurement points without and with magnification loupes and a mask.



Data analysis

Data for neck flexion were grouped into one of the categories from the Branson et al. PAI tool¹⁸ and were analyzed through descriptive statistics. Associations between the level of neck flexion and pain measures were analyzed using the Pearson and Spearman correlation coefficient methods to measure the strength of the association between two continuous variables: neck flexion and neck pain.

Results

Twenty-four second-year dental hygiene students consented to participate in the study. The female (n=22) and male (n=2) participants ranged in age from 21 to 47 years of age with a mean age of 27 years. All participants (n=24) demonstrated greater than 20° of neck flexion at the conclusion of the manual scaling session. The minimum degree of neck flexion measured was 30°, maximum was 63°, and the mean degrees of neck flexion was 42.5°. Using the categories established by the Branson et al. PAI, none of the participants were in the healthy range ($\leq 20^\circ$), two-thirds (67%, n=16) were in the compromised range (>20° and $\leq 45^\circ$), and one-third (33%, n=8) were in the harmful range (>45°).

Results from the McGill Pain Questionnaire were analyzed and showed the highest rated pain number was a 7 (8%, n=2) by participants while the most frequently indicated pain number was a 2 (29%, n=7). The Spearman correlation with pain score was (r) 0.29 (p=0.17) and the Pearson correlation with pain score was (r) 0.30 (p=0.14). The results showed no statistically significant association between neck flexion and neck pain (p<0.05).

Further data from the McGill Pain Questionnaire includes the top five pain associated words selected as aching (71%, n=17), tiring-exhausted (58%, n=14), throbbing (33%, n=8), tender (25%, n=6), and heavy (21%, n=5). The top five pain or problem areas selected were the shoulder/trapezius (63%, n=15), cervical (50%, n=12), low back (46%, n=11), (36%, n=9) scapular, and (21%, n=5) mid back. Shoulder/trapezius pain was evaluated with a mean degrees of neck flexion at 43°, with a minimum of 31° and maximum of 63°, as shown in Figure 2 The cervical region was also evaluated and matched with a mean degrees of neck flexion at 43°, with a minimum at 31° and maximum of 55°, as shown in Figure 3.

Participants answered two additional questions regarding the use of magnification loupes and any previous injuries to the head, shoulders or neck. All participants reported using magnification loupes while providing patient care and 8% (n=2) reported a history of a previous injury.

Discussion

Dental hygiene students are affected by the same workrelated MSD risk factors as practicing clinicians, with the neck, shoulders and lower back at high risk for pain.⁵ Research has shown that the appropriate degrees of forward neck flexion for dental professionals should be $\leq 20^{\circ}$.¹⁵⁻¹⁸ This study investigated the prevalence of neck pain in second year dental hygiene students to determine whether this pain was



Figure 2. Degree of neck flexion in participants reporting shoulder/trapezius pain.





associated with the levels of forward neck flexion during manual scaling procedures.

Findings from this study suggest that students may start to develop pain in the neck region, along with other areas, associated with excessive neck flexion during their dental hygiene education and support previous research reported in the literature. In a longitudinal study of MSDs in practicing dental hygienists and dental hygiene students, Warren et al. found that pain intensity in the neck and shoulders was primarily associated with bending of the neck and twisting.²¹ Morse et al. studied neck and shoulder pain in dental hygienists and students and found that the majority of the participants often worked with a bent neck and that over one-third (37%) of the dental hygiene student participants self-reported neck symptoms including throbbing, pain, aching, stiffness, burning, tingling, or numbness on a regular basis.¹¹ La Delfa et al. observed the demands of manual scaling on the shoulders and neck of practicing dental hygienists and found that the neck and shoulders were in extreme demand during a 30-minute manual scaling simulation and more notably the neck was in excessive flexion.²

All of the participants in this study wore dental loupes, an intervention to help decrease neck flexion, in addition to magnification of the work area.¹⁴ As suggested by Garcia et al., dental hygiene students should implement dental loupes beginning with pre-clinical work to help with posture and vision clarity.⁵ While all participants wore loupes in this study, musculoskeletal pain was still present.

One factor that could affect the amount of neck flexion and posture is inadequately fitted loupes. Dental loupes have three variables to assess when being fitted and it is possible that the working distance was measured too close, the declination angle not steep enough, or the frame size was too small. When all of these variables are measured correctly, the operator should be able to flex their neck at 20° or less.¹⁶ These variables should be performed correctly by the loupe fitters, however monitoring the fitting process can be difficult and the wearer may not be able to interpret proper fit.

This study had limitations. The sample size was small and limited to one institution. The small sample did not generate enough data to create a significant association between neck flexion and pain. While all the students wore magnification loupes, the fit of the loupes was not tested. Flexion was only measured from one position and may vary depending the area of instrumentation. Since the participants knew that they were being observed there may have been the Hawthorne effect on their positioning. Future investigation with a larger sample size and longer study period would increase generalizability. In addition, future studies would want to investigate more variables including the calibration of adequately fitted magnification loupes to better determine factors affecting the prevalence of work-related MSDs.

Conclusion

Dental hygiene students in this sample failed to maintain optimal neck flexion of less than 20° during a point in time instrumentation procedure while wearing magnification loupes. Fifty percent of the participants experienced cervical neck pain when exceeding a forward neck flexion of 20°. Shoulder/trapezius and cervical regions were most frequently identified as the location of pain or problems. An early prevalence of musculoskeletal pain was observed in this sample population of dental hygiene students. Dental hygiene students should be objectively examined for signs and symptoms of MSDs during clinical education.

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Innovations in Dental Hygiene Education

A 15-Minute Yoga Intervention to Reduce Entry-Level Dental Hygiene Student Stress

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Abstract

Purpose: Health science students have an increased source of stress due to the rigorous curriculum, high clinical expectations, and academic demands. The purpose of this study was to determine the effectiveness of a 15-minute yoga intervention to reduce stress in entry-level dental hygiene students.

Methods: First year dental hygiene students were invited to participate in the experimental study (n=32) and were randomly assigned to either the experimental or control group. The stress reduction intervention (gentle yoga movements, breathing, and meditation) was performed prior to each final exam for a total of six times. The control group proceeded with their usual pre-exam routines. Baseline and post-trial blood pressure, pulse and 10-item Perceived Stress Scale (PSS) data were recorded for both groups. Repeated measures of blood pressure and pulse were recorded before and after yoga for the experimental group and the control group prior to each exam. Data analyses included *Paired-samples t-test, Independent-samples t-test* and ANOVA, (p=0.05).

Results: The main effect for yoga from pre- to post-session was statistically significant for blood pressure (p=0.02 systolic; p=0.02 diastolic) but not for pulse (p=0.23). Significant effects on blood pressure measures showed yoga movement sessions reduced stress however the effects sizes were small. The *paired t-tests* indicated the 10-item PSS values were significantly lower (p<0.00). Statistical significance of differential, beneficial effects of yoga versus control were not demonstrated.

Conclusions: Fifteen-minutes of yoga movements had feasibility, compliance, and appeared to have positive effects related to stress reduction. No evidence of statistical significance was demonstrated compared to the control. Research on a larger sample of entry-level dental hygiene students using yoga movements over the course of a semester is recommended.

Keywords: stress reduction, stress management, dental hygiene students, yoga, physiological measures

This manuscript supports the NDHRA priority area, **Professional Development: Occupational health** (methods to reduce occupational stressors).

Submitted for publication: 2/21/20; accepted: 8/31/20

Introduction

Stress is a physical, psychological, or emotional response to an internal or external demand.¹ Stress can be beneficial by enhancing productivity and motivation, or stress can be crippling, reducing performance. The bidirectional relationship between individuals and their environments is complex and influential because stressors from daily situations can physiologically and psychologically be considered a threat to the body.² Extended periods of stress can disrupt normal biological functions; this prolonged strain on the body may contribute to health problems.¹ College students are particularly vulnerable to stress due to the fluctuating nature of college life in general.² Evidence of college stress was found in the American College Health Association (ACHA) survey data which concluded 44% of the respondents felt enormous stress that negatively impacted their academic and personal lives.³ Health science students, including entry-level dental hygiene students, have increased sources of stress due to the rigorous curriculum, high clinical expectations, and academic demands.^{2,4,5} Challenging course work, the number and complexity of assignments, exams, lack of control, fear of failing, and uncertainty about the future, are examples of additional stressors in academic dental hygiene programs.⁵ Clinical stressors include manual dexterity skills, transition to patient care, completing clinical requirements, clinical decision making, rotating faculty, time management, and grade concerns.⁵ These issues are cause for immediate concern for college students' psychological and physiological health. Safe and feasible stress reduction interventions for college students, including dental hygiene students, are needed.^{2,4,5}

Yoga has been accepted as a natural, popular practice to achieve and maintain physical and emotional health and is considered an alternative therapy to address mind-body needs.^{6,7} Yoga is a Sanskrit word that comes from the Sanskrit root "yuj" which means to connect, join or balance and represents the suppression of the modifications of the mind to enhance one's inherent force in a balanced manner to obtain self-realization.8 Various styles of yoga are practiced including Vinyasa (athletic yoga), Hatha (beginner poses), Iyengar (alignment poses), Kundalini (invigorating poses), Ashtanga (physically demanding poses), Bikram (poses performed in sauna like temperatures, "hot yoga"), and Restorative (props used for deep, extended relaxation). Many yoga sessions include both Asanas and Pranayamas for various lengths of time to target and enhance the mind-body connection.⁸ Asanas are physical poses and movements; Pranayama is referred to as breathing regulation.

Yoga appeals to a wide range of individuals seeking natural control over their health, including stress management, and can also serves as a preventive lifestyle enhancement. National surveys and reports in the literature from 2012 - 2016, affirm the exponential growth in the practice of yoga from 21 million to 36.7 million users.⁹ Health promotion and disease prevention have been identified as the leading reasons for the practice of yoga.⁹⁻¹¹

A review of the literature was conducted to establish the existing body of knowledge on the benefits of yoga. Heart rate variability (HRV) is one of the physiological indicators for stress. In a study conducted to observe the impact of an eightweek yoga program on heart rate variability (HRV) and mood in generally healthy women, indicators for stress, anxiety, and depression were also observed.¹² The intervention participants (n=26) were instructed to attend a 60-minute yoga session twice a week; the control group (n=26) was advised to do nothing physical outside their normal activities.¹² Participants in the yoga intervention group demonstrated a statistically significant reduction in anxiety (*p*=0.01), evidence of yoga's anxiolytic effect in healthy women; however, yoga was not found to be significantly effective in managing depression or stress in this study.¹²

A systematic review and meta-analysis was performed to examine the effectiveness of yoga on Positive Mental Health (PMH) in healthy adults to determine whether a correlation exists.¹³ Four indicators were identified that correlated to PMH: psychological well-being, life satisfaction, social relationships, and mindfulness.¹³ Yoga was found to be significantly correlated to an increase in psychological well-being.¹³ The review authors recommended future researchers to measure positive outcomes from yoga use, since the vast majority (95%) of the current research measures negative outcomes.¹³

The emotional and physical stress that healthcare professionals face working in the healthcare fields can cause burnout, reduced quality of life, and other negative health effects. For these reasons, yoga and work-related stress in mental health professionals was studied in a 12-week, randomized controlled trial with a one-hour weekly session of yoga intervention.¹⁴ The researchers collected data by self-administered questionnaires and measuring heart rate variability, and the results indicated that the yoga intervention had a statistically significant effect on work-related stress.¹⁴

Studies in educational settings offer a unique perspective on various levels of maturity and cognitive development of the practitioner in relation to yoga's impact on stress, mood, performance, emotion, behaviour, and strength. To better understand the psychological effects of yoga on college students, a study was performed to initiate evidence of Vinyasa yoga's acute effects on college age students' stress levels.¹⁵ Participants were encouraged to attend yoga classes twice a week with each Vinyasa style session lasting approximately 90 minutes.¹⁵ Data analyses resulted in a statistically significant increases in positive effect scores on mood.¹⁵

Due to the increasing levels of stress students experience throughout their dental education,^{4,5} research has been conducted related to yoga and dental students. To examine yoga's efficacy in lowering student anxiety levels prior to performing their first periodontal surgery a randomized control trial was conducted with a convenience sample of 100 undergraduate dental students.¹⁶ The intervention group was instructed to practice the recommended yoga strategies at least once a day or as needed.¹⁶ The control group was provided with a 60-minute lecture on stress, anxiety, and health and were given a cassette tape with the sound of ocean waves.¹⁶ Yoga was shown to be effective at lowering pre-procedural stress and anxiety levels and improved the dental students' ability to relax when compared to the control group.¹⁶

While numerous stress reduction treatments and pharmacological interventions are available, little is known about the effect yoga has on entry-level dental hygiene students' stress. The purpose of this study was to determine the effectiveness of a 15-minute yoga intervention to reduce stress in entry-level dental hygiene students.

Methods

The Human Subjects Committee of Idaho State University granted this study exempt status based on the educational intervention (IRB-FY2019-215). This study was a nonblinded randomized control trial conducted on healthy first year entry-level dental hygiene students during finals week, which was intentionally selected as a potentially stressful time in their curriculum. Members of the first-year dental hygiene class were invited to participate in the study (n=32). Inclusion criteria were first-year entry-level dental hygiene students over the age of 18 and an in good health, as defined by no significant health conditions based on a health history evaluation. Written informed consent was obtained from all participants prior to the study.

Subjects were randomly assigned to two groups: a 15-minute yoga experimental (n=16) or a control group (n=16) using a random number generator. The participants' previously completed and updated health histories were reviewed, and blood pressure and pulse were assessed for outliers. Outliers and <10% baseline variation were evaluated and accounted for to ensure equal distribution between groups. Participants were screened for previous yoga and/ or mindfulness activities prior to the trial to ensure internal validity. During finals week (April 29-May 2019), the experimental yoga group participated in a 15-minute yoga intervention session prior to each examination (two per day, six total). The control group was instructed to avoid physical activities including yoga during this time period and to continue their normal routines prior to testing during finals week. The control group confirmed they would not typically be performing any particular physical activity prior to any final examination. Figure 1 provides a flow diagram of the study profile.

The 15-minute yoga intervention was conducted by video session immediately prior to each final examination. The video was selected because the Hatha and Iyengar style of movements and breathing are known to specifically reduce stress and are appropriate and safe for beginners. The session was presented by a certified yoga instructor from YogaTX's free website.¹⁷ Relaxing music accompanied the verbal and visual instructions; deep breathing, inhalations and exhalations, were verbalized by the instructor to accompany movements.

The physical movements involved four steps. Step one, in

Figure 1 Methodology flow chart



a supine position on a yoga mat, slow purposeful arm and hip movements were added to each breath. Step two, gentle spine-twisting was performed during a side-supine position. Step three, in a supine position, gentle knee movements with each breath commenced. The final sequence included a twoand-a-half-minute guided meditation and breathing posture, Savasana, in a supine and static position. This intervention was performed by the experimental group prior to each final examination for a total of six times. The principal investigator (PI) monitored each session to ensure that each step was performed as specified and all six sessions were completed.

The physiological variables (blood pressure and pulse) were measured using a new, calibrated automated electronic blood pressure and pulse wrist cuff. Permission was provided to use the 10-item Perceived Stress Scale (PSS), a self-reported stress survey designed to measure perceptions of stress.¹⁸ The PSS, composed of 5-positive and 5-negative items rated on a

5-point Likert scale, was administered to both groups prior to the first exam and following the last exam.¹⁸ The PSS has structural validity ranging from 0.78 to 0.87 and test-retest reliability was >0.70.¹⁹ The PSS form is shown in Figure 2.

The groups were normally distributed. *Paired-samples t-test, Independent-samples t-tests,* and two-factor repeated ANOVAs were used to analyze data. The level of significance was set at p=0.05.

Figure 2. Perceived Stress Scale (PSS)¹⁸

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

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		Never	Almost Never	Sometimes	Fairly Often	Very Often
1.	In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2.	In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3.	In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4.	In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5.	In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6.	In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7.	In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8.	In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9.	In the last month, how often have you felt angered because of things that were outside of your control?	0	1	2	3	4
10.	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

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Results

A total of 32 first year dental hygiene students consented to participate in the study. All participants identified as females; the majority were Caucasian (n=29) and Hispanic (n=3), ranging in age from 20 to 37 years. Between group differences were not significant in relation to their age, education, yoga/mindfulness experience, or health status. Two students from the control group did not arrive prior to the second exam in time to have their blood pressure and pulse recorded and one participant did not take the baseline 10-item PSS. Otherwise, no other data were missing for the measures collected in this study.

Effect of yoga sessions on physiological stress

The effect of yoga was measured in blood pressure and pulse taken before and after each session prior to each of the six exams in the experimental group (Table I). This was a 2 by 6 repeated measures design. Preliminary analyses indicated the assumption of sphericity was met for all the repeated measures factors except for the interaction effect for diastolic blood pressure where the reported p value is for Greenhouse-Geisser adjusted test.

The separate two-factor repeated-measures of ANOVA revealed a statistically significant main effect for pre-exam physiological stress for systolic blood pressure (p=0.02), diastolic blood pressure (p<0.00), and pulse (p<0.00). As shown in Table I, the mean systolic blood pressure, diastolic blood pressure, and

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Total
	M(SD)*	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	М
Systolic	111.4	111.5	111.7	110.7	116.3	109.7	111.9
Before	110.1 (10.1)	113.4 (11.0)	116.3 (12.2)	110.1 (6.9)	119.0 (11.5)	111.5 (8.8)	113.4
After	112.7 (14.8)	109.6 (13.2)	107.1 (10.4)	111.2 (10.9)	113.6 (14.3)	107.8 (7.5)	110.3
Diastolic	75.2	75.2	75.5	72.3	80.7	77.0	76.0
Before	74.2 (8.9)	76.5 (7.5)	79.4 (10.9)	72.4 (7.1)	81.1 (11.6)	79.6 (11.2)	77.2
After	76.3 (8.9)	73.8 (9.2)	71.6 (9.6)	72.3 (9.3)	80.3 (12.8)	74.4 (8.3)	74.8
Pulse	82.5	78.6	79.8	89.8	83.4	82.6	82.8
Before	84.1 (14.2)	78.6 (13.6)	82.1 (14.6)	90.1 (13.0)	85.5 (15.8)	81.1 (12.5)	83.6
After	80.9 (15.7)	78.6 (9.3)	77.3 (10.8)	89.4 (17.8)	81.3 (15.9)	84.2 (13.0)	81.9

Table I Means for blood pressure and pulse taken before and after each yoga session (n=16).

*M=means; SD=Standard deviations

**Two-factor repeated-measures of ANOVA

pulse varied across exams. The main effect for yoga from presession to post-session was statistically significant and *Cohen's d* effect sizes were small for systolic blood pressure (p=0.02, d=-0.36) and diastolic blood pressure (p=0.02, d=-0.35), but not statistically significant for pulse (p=0.23, d=0.18). The *Cohen's d* effect sizes were small, but the significant effects on the blood pressure measures showed the yoga sessions impacted stress levels.

The interaction effect for yoga from pre-session to postsession by yoga session was also statistically significant for systolic blood pressure (p=0.01) and diastolic blood pressure (p<0.00), but not for pulse (p=0.37). For systolic blood pressure, the means were higher before the yoga session than after the yoga session with the exception of Exam 1 and Exam 4. For diastolic blood pressure the means were higher before the yoga session than after the yoga session with the exception of Exam 1, Exam 4, and Exam 5. Together, the results indicated the yoga sessions had small effects on systolic and diastolic blood pressure across the pre-exam yoga sessions, but the effects varied by exam. The yoga sessions did not affect pulse rates.

Effect of yoga on pre-exam stress compared to control

The effect of yoga versus the control (no yoga) on the three measures of pre-exam stress (pulse, systolic blood pressure, and diastolic blood pressure) was evaluated across five of the exams. Exam 2 was excluded from these analyses due to the loss of data from two participants in the control group. The design was a 2 by 5 mixed design with each pre-exam occasion serving as a fixed repeated measures factor. The means are presented in Table II. Preliminary analyses indicated the assumption of sphericity was met for the repeated measure factor for pulse but not for systolic or diastolic blood pressure. Consequently, reported p values are for Greenhouse-Geisser adjusted tests for the repeated measures effects for blood pressure. The between groups effect of yoga was not statistically significant for any of the stress measures (p=0.35 for systolic, p=0.46 for diastolic, and p=0.68 for pulse). Cohen's d effect sizes reveal the difference between the mean of the yoga group and the control group were d=-0.15 for systolic blood pressure, d=-0.12 for diastolic blood pressure, and d=0.06 for pulse. The effect sizes were all negligible.

The effect of exam was not statistically significant for systolic blood pressure (p=0.19), but it was statistically significant for diastolic blood pressure (p < 0.00), and pulse (p<0.00). For diastolic blood pressure, the mean was highest for Exam 5 and lowest for Exam 4. For pulse, the mean was highest for Exam 4 and lowest for Exam 3. The interaction effect was statistically significant for systolic blood pressure (p=0.01), but not for diastolic blood pressure (p=0.06) nor pulse (p=0.46). Multiple comparisons of the yoga conditions across the five exams applying a Bonferroni adjusted significance criterion of $p \le 0.01$ for the five tests indicated the locus of the interaction effect on systolic blood pressure occurred at Exam 6 (p < 0.00). No other differences were statistically significant. Yoga (M=107.8) lowered systolic blood pressure before the last exam (Exam 6) compared to no yoga (M=116.9, d=0.77) showing a medium effect size.

		Exam 1	Exam 3	Exam 4	Exam 5	Exam 6	Total
	N or n	M(SD)*	M(SD)	M(SD)	M(SD)	M(SD)	М
Systolic	32	112.1 (13.3)	111.3 (11.1)	109.2 (10.0)	114.5 (13.5)	112.3 (9.4)	111.9
Yoga	16	112.7 (14.8)	107.1 (10.4)	111.2 (10.9)	113.6 (14.3)	107.8 (7.5)	110.5
Control	16	111.5 (12.1)	115.6 (10.3)	107.3 (9.1)	115.4 (13.2)	116.9 (9.0)	113.4
Diastolic	32	74.8 (8.8)	74.7 (9.5)	72.6 (8.7)	80.2 (12.6)	77.2 (8.4)	75.9
Yoga	16	76.2 (8.9)	71.6 (9.6)	72.2 (9.3)	80.2 (12.8)	74.4 (8.3)	74.9
Control	16	73.3 (8.8)	77.9 (8.5)	73.0 (8.2)	80.2 (12.9)	80.1 (7.9)	76.9
Pulse	32	79.9 (12.7)	76.4 (12.0)	88.5 (17.1)	83.5 (13.2)	81.2 (12.6)	81.9
Yoga	16	80.9 (15.7)	77.3 (10.8)	89.4 (17.8)	81.2 (15.9)	84.2 (13.0)	82.6
Control	16	79.0 (9.4)	75.4 (13.3)	87.6 (16.8)	85.8 (9.8)	78.3 (11.9)	81.2

Table II Means	s for pre-exam stress	measures for e	experimental gr	roup compared	d to control	group

*M=means; SD=Standard deviations

Effect of yoga on perceived stress compared to control

The score for one entry-level dental hygiene student in the control group was not available for the baseline measure of the 10-item PSS. Scores were available for all participants for the 10-item PSS measure collected at the conclusion of the study. Based on independent *t-tests*, the yoga group (n=16, M=23.0, SD=5.5) and the control group (n=15, M=21.7, SD=6.6) did not differ statistically (p=0.54) with respect to their mean baseline 10-item PSS scores at the beginning of the study but the mean perceived stress was lower in the control group. The yoga group (n=16, M=21.3, SD=5.9) and the control group (n=16, M=22.2, SD=7.6) also did not differ significantly (p=0.68) at the conclusion of the study. However, the results of paired t-tests indicated the 10-item PSS scores were significantly lower (p < 0.00) at the conclusion of the study for the participants in the yoga group (Mean Difference=-1.8, SD=1.8, d=-1.0), but were not significantly lower (p=0.82) for the participants in the control group (Mean Difference=0.2, SD=3.4, d=0.06). The effect size of the difference for the yoga group was large.

Discussion

This study sought to understand whether yoga provided a non-pharmaceutical stress management solution for entry-level dental hygiene students. Existing literature has demonstrated yoga's use as a natural stress management option for various populations including persons clinically diagnosed with stress and anxiety, work burnout, decreased mental health, non-clinical, and dental student populations.¹²⁻¹⁶ During an eight-week yoga intervention study, heart rate variability was not affected yet anxiety scores were significantly reduced in the yoga versus the control group.¹² It was recommended to study yoga's effect on participants with higher stress levels.¹² Therefore, this study enrolled entry-level dental hygiene students in a highly stressful time during their curriculum to evaluate yoga's effect. Results from this study indicate that yoga reduced the perceived stress of the experimental group as compared to the control group. In another study examined the effects of a one-hour yoga intervention on perceived stress and mindfulness in dental hygiene and dental studentswere examined.²⁰ Findings suggested that even a brief yoga intervention could be especially effective at increasing a state of mindfulness for students with high levels of stress.²⁰

Compliance was a barrier for the college student participants during an eight-week randomized control trial.¹⁵ The experimental group attended two Vinyasa 90-minute yoga classes a week, resulting in a significant increase in mood for the yoga group, however, no statistical change occurred in other domains.¹⁵ The authors' attributed insignificant statistical findings across all domains to a lack of compliance in the experimental group and a moderately-physical active control group.¹⁵ In comparison, this study used a no-treatment control, a short yoga intervention, and a convenient location. As a result, compliance was more successful and demonstrated that 15-minutes of yoga can be easily integrated into academic routines in educational settings.

Another study analysed the impact of an extended duration and more intense Bikram 90-minute yoga sessions three to five times a week over a period of 16 weeks.²¹ Yoga class attendance was a powerful indicator of success, as the

improvements were directly proportionate to the number of classes taken by the experimental group.²¹ Similar to previously discussed research, compliance was the primary limitation to the study's success. Conversely, in this study the compliance barrier was overcome by reducing the duration and intensity of the yoga sessions for the experimental group.

Yoga and meditation have been explored to improve the psychological and physical well-being of healthcare workers to manage and prevent stress and burnout.²² A systematic review of clinical trials analyzing yoga interventions and stress levels, sleep quality, and quality of life among healthcare workers demonstrated that yoga appears to be effective in the management of stress in these individuals.²² This study of entry-level dental hygiene students sought to address student stress management prior to entering the healthcare workforce. Because the literature on dental hygiene students' stress management is in its early stages, it is important to conduct more research with varying styles and duration of yoga among dental hygiene students to broaden the body of knowledge. Yoga is new to dental hygiene as a stress management strategy and developing a range of interventions is worth investigating.

Compliance was found to be a primary limitation in yoga's effectiveness across the literature. A strength of this study was the high-level of compliance which offers solid evidence that yoga may be implemented into the entry-level dental hygiene curriculum to potentially help manage student stress. Furthermore, exposure to stress management options like yoga during their education may help future professionals cope with workforce stress and enhance their career satisfaction and longevity. Additional strengths of this study include the randomized control trial design, with a no-treatment control, and the inclusion of valid and reliable physiological and psychological measures. The yoga intervention, which was delivered via a video, provided consistency and feasibility and increased participant compliance.

There were also several limitations to this study. Small sample size limited the power of the statistical analysis and generalizability of the findings. Finals week may not have been the ideal time to introduce yoga because the condensed exam schedule may have been too intense of a time period to conduct a research study. Bias was minimized by having a trained statistician manage all data which was de-identified. A larger sample and more robust population are suggested to add power to detect and increase greater effect size and generalizability. Future researchers are encouraged to increase frequency and possible duration of yoga interventions over the course of a semester or academic year. Various styles of yoga should also be explored for stress reduction including Restorative yoga. Additional research is warranted related to dental hygiene students because this population has been identified as being at risk for higher levels of academic stress.

Conclusion

A 15-minute yoga intervention was studied among entry-level dental hygiene students during the final examination period in their second semester. Measures included the 10-item PSS, blood pressure, and pulse. Results demonstrated statistically significant positive effects on stress measures, particularly blood pressure, within the yoga group. However, statistical significance of the differential, beneficial effects of yoga versus control were not demonstrated. This study provides evidence of yoga's positive effects in both physiological and psychological domains within entry-level dental hygiene students. High levels of compliance were achieved and demonstrated yoga's feasibility even during a highly stressful time for entry-level dental hygiene students.

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