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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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Interprofessional Education: Opportunity for Advancement

Danielle Furgeson, RDH, MS, DHSc

Since the early 2000's, oral health has gained prominence as an integral part of total health. At the same time, interprofessional education (IPE) and interprofessional collaboration (IPC) were also emerging as a new way to approach health care in a manner that addressed the complex needs of patients. IPE refers to when students from at least two disciplines have courses together either discretely, or across the entire curriculum.[1] Dentistry was slow to engage in this emerging practice model, struggling internally over whether or not to join the IPE movement.[2] Almost ten years following the Surgeon General's Report on Oral Health in America, dentistry included explicit IPE statements in their accreditation standards. Dental hygiene accreditation standards, however, continued to remain silent on the subject until 2016.

Continued demands for access to oral health care, dental hygiene's focus on primary and secondary prevention, and the significant educational background required for analyzing the impact of systemic conditions and medications on oral health, have made incorporating the dental hygienist on IPC teams a logical fit.[3-4] The introduction of the Affordable Care Act (ACA) in 2010 completely changed the way we look at health care, with its focus on prevention and health outcomes over procedure-based care, making IPE and IPC imperative. The ACA also came at a time when the momentum that had been building for the expansion of dental hygiene workforce models to address access to care was also beginning to get traction. Workforce models continue to expand across the country today, with 10 states now having legislation for dental therapy. Dental hygiene now stands at the convergence of these developments, with a potential future of significant opportunity for the profession to continue advancing by taking a prime role in IPE and IPC.

The stage has been set for dental hygiene to raise its profile by engaging with other disciplines outside of dentistry to demonstrate the value of the dental hygienist as an integral part of the IPC team. In order to seize this opportunity, it is imperative to incorporate IPE into dental hygiene education and practice. Any paradigm shift towards engagement in IPE must originate with our educators.[2-5] In 2016, dental hygiene joined the ranks of health-related disciplines with accreditation standards geared towards IPE. Standard 2-15 of the Commission on Dental Accreditation (CODA) Accreditation Standards for Dental Hygiene Education was amended to state, "Graduates must be competent in communicating and collaborating with other members of the health care team to support comprehensive patient care."[6] This simple but significant amendment effectively charges dental hygiene education programs to include IPE in order to prepare a dental hygiene workforce that can engage with other health care providers as part of IPC teams.

It is often said that clinicians will practice how they have been taught once they obtain licensure; anywhere from how they approach a given clinical procedure to brand product purchases. Professional identity is also learned during the education experience, with the education process itself being a cultural immersion into the discipline. Dental hygiene education should be the place where the acculturation process includes learning to be an fundamental part of the IPC team.

The integration of IPE and IPC into dental hygiene education is definitely a culture shift that requires buy-in from educators. Such changes do not come without challenges. Dental hygiene educators are hard-pressed to add anything extra to their curricula, demands on faculty time are substantial, and lack of support from administration are all challenges that cannot be taken lightly. However, the risks of not seizing this opportunity are significant.

There are potential dangers in choosing not to embrace IPE and IPC in dental hygiene education. At the extreme end of the spectrum, disrespect, lack of teamwork and engagement can cause psychological harm and lead to low career satisfaction.[7] Professional identity can also be impacted

when IPE experiences are missing from the curriculum. Lack of collaborative engagement with other disciplines in health professions curricula has frequently resulted in misconceptions regarding the education and scope of practice of other health care providers.[8] This has often been the case for dental hygiene, even within dentistry. These misperceptions have created hierarchies that are difficult barriers to surmount in creating IPE experiences as well as in clinical practice.

Negative perceptions of a particular discipline have been shown to not only impact the manner in which other professions engage with that discipline, but also how members of that particular discipline perceive themselves as professionals.[8] One particular study noted that dental hygienists were perceived, more than any other participating discipline, to be lacking in academic ability, decision-making, and leadership skills. However, these negative perceptions were shown to be significantly diminished after the IPE intervention.[8]

Changing perceptions can often be that simple. For example, a recent IPE course at the University of Michigan brought together graduate dental hygiene, graduate social work, and doctor of nurse practitioner students. The Student Stereotype Rating Questionnaire used in the previously mentioned study was given to participants pre- and post-IPE course. Across the board, perceptions of dental hygienists significantly improved after the IPE experience. One participant stated, "It was helpful having dental hygiene here because I learned so much about their studies and practice." If other health care disciplines do not work with dental hygiene during their education, how will they learn how valuable dental hygienists can be to their patients' care?

Herein lies rich opportunity to promote the profession by engaging our students and faculty with other disciplines during the education process. Who knows better than our own educators how qualified dental hygienists are, by virtue of the breadth and depth of their education, to competently and confidently contribute to IPC? As the profession's scope of practice continues to rapidly evolve, IPE will not only become more inherently necessary, it will continue to offer a pathway to advocate for and advance the profession as part of the IPC team.

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Research

Attitudes and Access Patterns of Michigan Veterans Ineligible for Oral Healthcare Benefits: A cross-sectional study

Valerie Nieto, RDH, BSDH; Michelle Arnett, RDH, MS; Danielle Furgeson, RDH, MS, DHSc

Abstract

Purpose: Strict eligibility criteria exclude a majority of the veteran population from receiving oral healthcare benefits through the Veterans' Administration Dental Care program (VADC). The purpose of this study was to examine perceptions of oral health status, and access/barriers to dental care of veterans who are ineligible for VADC benefits.

Methods: This cross-sectional study was conducted using a 24-item paper survey, disseminated in person to 227 veterans across the state of Michigan over a period of two months. Items included socio-demographic information, questions regarding perceptions of oral health, access to dental care, and perceived barriers. Descriptive statistics were collected to provide an overview of the data.

Results: A response rate of 80% (n=182) was achieved. Veterans who perceived themselves as having a poor oral health status were less likely to have a dental home (p=.000) or receive dental care (p=.001). Respondents were more likely to report cost as a barrier (p=.000), and to report having had a toothache during the past 12-months (p=.000).

Conclusion: Results from this study indicate that while veterans in general value the importance of oral healthcare, cost and time are significant barriers to accessing dental care for individual's ineligible for VADC benefits. Veterans who perceive themselves as having poor oral health are more likely to report oral health disparities. Further research is needed to impact Veterans Administration policy and decrease oral health disparities.

Keywords: Veterans' oral health, dental insurance, oral health benefits, oral health disparities, access to care

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Introduction

Determinants of oral health are highly dependent upon a wide range of social contexts. Factors such as access to health insurance and geographic location, in turn, are affected by the social contexts of socioeconomic status derived from education and employment. The oral health objectives of Healthy People 2020 identify visiting a dentist in the previous 12 months as the leading indicator of oral health.[1] Access to oral healthcare is a significant challenge for a large portion of the United States (U.S.) population, but often more acutely for the veteran population. While in active service, members of the military have universal, and regularly required access to oral healthcare, but upon separation from the military, this access to care ends.[2]

Approximately 20 million veterans currently reside in the U.S.[3] While the U.S. Department of Veteran Affairs (VA) is intended to serve as a safety net, nearly 1.5 million veterans lack health insurance,[4] and fewer than half, (9 million) are enrolled in VA healthcare programs.[5] While some literature indicates that veterans are more likely to indicate having a primary care provider as compared to civilians, they are also more likely to report their health as being fair or poor.[5]

Oral healthcare is not included in the VA standard medical benefit package, and eligibility is determined through a strictly defined separate classification system that actually excludes the majority of veterans.[7,8] Criteria to qualify for VADC include service-connected compensable oral conditions; service-connected oral conditions that aggravate a service-connected disability; service-connected disabilities rated at 100%, or a 100% unemployable rating; former Prisoners of War (POW); veterans in vocational rehabilitation programs; and individuals receiving VA medical care whose oral conditions complicate their medical condition.[7] Within the

VA system, dental care for veterans has been noted as being disproportionately distributed to providing services to those 65 and older, thus introducing disparities for the growing younger segment of the veteran population within a system intended to support their healthcare needs.[9] When combined with other significant challenges veterans frequently face, disparities in access to oral healthcare for this population become more significant.

Oral Health Risks

Combat exposure and service to country increase a veteran's risk of oral health disparities.[10–12] Studies have shown increased prevalence of periodontal disease, decay, and temporal mandibular disorders in combat veterans.[10,12] A 2017 survey from the Centers for Disease Control and Prevention (CDC) reported that 61% of veterans had a history of tobacco use while 16% reported being current users.[13] One quarter of post 2001 era veterans reported alcohol misuse and 53% reported binge drinking.[14] Opioids and psychotropic medications are frequently prescribed to treat the increased prevalence of polytrauma and mental illness diagnosed in veterans.[11,15,16] Oral side effects of these drugs frequently include xerostomia, impacting the severity of oral diseases.[17,18] Increased risk of oral disease also contributes to the vulnerability of the veteran population, making access to care more significant in terms over overall quality of life.

Barriers

Mental health disorders can be compounded by social comorbidities. The unique military culture encompasses engrained, rigid principles of self-sacrifice, alertness, dress, and attitude can significantly impact a veteran's ability to return to the unstructured world of civilian life.[19] Poor physical and mental health have been shown to significantly impact daily activities in the veteran population as compared to the civilian population,[5] creating economic and social challenges and elevating the risk for poor oral health.

As in the general population, education and socioeconomic status are significant barriers to oral healthcare. Almost half of uninsured veterans are 45 years old or younger and have a lower level of education as compared to insured veterans.[20] This is of significance as many members of this younger veteran generation have inadequate education, training, or experience outside of the military to make them employable for careers offering medical and dental benefits.[20] Previously combat deployed veterans may face additional post-military service employment challenges, as research indicates that this group does not have the same opportunities for career development in the civilian sector.[21,22]

Veterans have been noted to have a more difficult time obtaining employment in general. Veteran unemployment status, 13%, is disproportionate to the general population.[13] In addition, unemployment, particularly long-term, has been linked to a general deterioration in health and chronic disease, placing veterans uniquely at risk.[22,23] Service-connected disabilities and mental health issues can also become barriers, as employers consider them as potential cost liabilities.[22,24] Unemployment also impacts day-to-day functionality. Lack of finances deeply impacts food and housing insecurity, which can be significantly amplified in veterans with physical and mental health disabilities.[22]

Veterans also comprise a disproportionate percentage (10-33%) of the homeless population in the U.S.; veterans with combat experience are more likely to face homelessness.[25 - 27] Literature shows that the lack of access to oral healthcare is ranked in the top three biggest concerns of homeless veterans.[28] Moreover, veterans experiencing any of the barriers previously discussed were more likely to report having poor or fair oral health, with financial hardship preventing them from seeking dental care.[29]

Limited research for veterans' oral healthcare

Research is limited regarding oral health in the veteran population, especially in regard to how non-VADC eligible veterans' access or pay for oral healthcare services. The Veterans' Health Administration (VHA) within the VA is the largest healthcare organization in the country, providing medical care to nearly nine million veterans nationwide.[13,5] As a result, there is a vast amount of research regarding veterans' access to healthcare, however, data is limited regarding access to oral healthcare.[13] Additionally, little is known regarding veterans' oral health perceptions creating a critical gap in the literature, as oral health perceptions have been shown to influence the receipt of dental care.[3] The purpose of this study was to examine perceptions of oral health status, and access/barriers to dental care of veterans ineligible for Veterans' Administration Dental Care (VADC) in the state of Michigan.

Methods

The University of Michigan (U-M) Institutional Review Board approved this cross-sectional study as exempt from oversight (HUM00127688). A convenience sample of veterans (n=227) affiliated with VFW Posts, American Legion Posts, Team Red White and Blue (RWB), the Patriot Guard Riders, and student veterans at Ferris State University (FSU) participated in this study.

A 24-item paper survey was developed. Questions included demographic information (military branch, separation of service, years served, age, and sex), questions related to a service-related disability, eligibility of VA medical care and dental care, and the respondents' ability to independently perform daily personal oral hygiene tasks. Five-point Likert-scale questions assessed perceptions regarding the importance of oral health, including perceptions regarding their own oral health. Additional questions assessed whether the respondent had a dental home, the time frame of the last dental visit and type of appointment, whether the respondent had a toothache in the last 12 months and how it was managed, and questions regarding dental insurance coverage and barriers to care. Two open-ended questions addressed additional dental concerns and comments.

The survey was pilot tested by six subjects; three dental hygiene faculty members, and three veterans who receive medical care at the VA. A feedback form was attached to the pilot survey, and revisions were made based on the feedback. Paper surveys were then disseminated at veteran organizations by the principal investigator over a period of two months. A cover letter explaining the purpose of the study was attached to the survey and served as an informed consent.

Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 25.0; Armonk, NY) was utilized for data analysis. Frequency distributions, mean, and standard deviations were analyzed to provide an overview of the data.

Results

A response rate of 80% (n=182) was achieved. The age range of respondents was almost equally divided between elderly veterans (65 years of age or older) and non-elderly veterans (18-64 years of age). The majority of respondents (94%) reported being honorably discharged or retired, making them eligible to apply for VA healthcare and service-connected disability ratings. Table I provides an overview of the respondent's demographic information, service connected disability rating, and type of VA healthcare received by veterans.

Veterans' access and funding of dental care

Among the 182 respondents, 80% (n=145) reported that they were ineligible for VADC, with 6% indicating that they have utilized VADC benefits. Of those who did not qualify for VADC, 40% reported that they lacked dental insurance coverage (Figure 1). Of those who reported not having any dental insurance benefits, 38% percent indicated that cost of care has prevented them from receiving dental treatment.

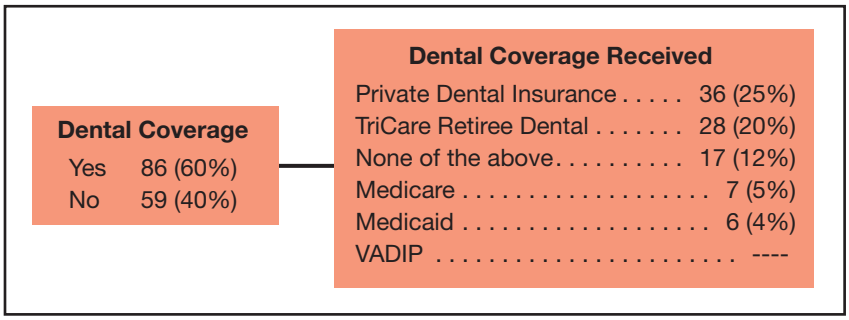
Information regarding dental home, frequency and reason for their last dental appointment is shown in Figure 2. Over half of the VADC ineligible respondents reported having a dental home, and 59% reported having been seen by a dentist in the previous three to six months. However, 17% indicated they had not been seen in three or more years, and 5% could not remember when they had their last dental appointment. Preventive appointments were reported as the most common type of dental appointment followed by treatment, emergency, and problems with a denture or partial.

Table I. Sample demographics (n=182)

Separation of Service	**n (%)***
Honorable discharge	156 (85%)
Retired	14 (8%)
Medically discharged	6 (3%)
Medically retired	5 (3%)
Other	1(1%)
Age	**n (%)**
65 years +	99 (54%)
46-64 years	39 (21%)
31-45 years	26 (14%)
18-30 years	18 (10%)
Service related disability	**n (%)**
Yes	82 (45%)
No	100 (55%)
Disability Rating	**n=82 (%)**
Less than 20%	19 (22%)
20-40%	20 (24%)
40-60%	6 (7%)
60-80%	12 (15%)
80-90%	7 (9%)
100%	6 (7%)
100% unemployable	12 (15%)
Qualify for VA Dental Care	**n=182 (%)**
Yes	37 (20%)
No	145 (80%)
Utilize VA Dental Care	**n=37 (%)**
Yes	11 (6%)
No	26 (14%)
Receive VA medical care**	**n=181(%)**
Yes	98 (54%)
No	83 (46%)

*Percentages rounded to the nearest whole number
*one respondent missing

Figure 1. Dental insurance coverage of veterans ineligible for VADC (n=145)



*respondents checked all dental insurance benefits that applied

Figure 2. Dental home and appointment description in veterans ineligible for VADC benefits (n=145)

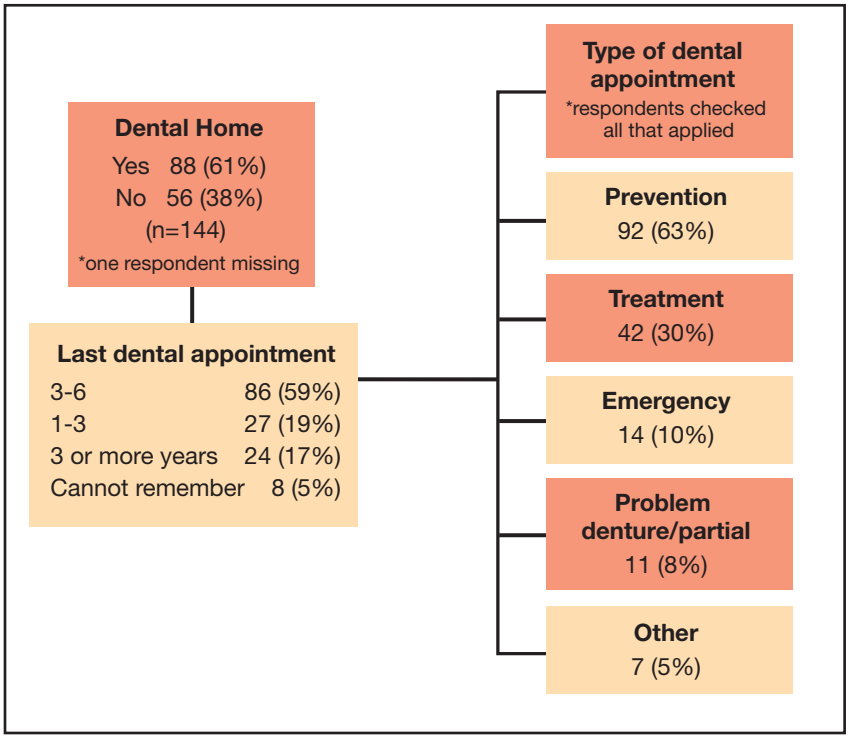
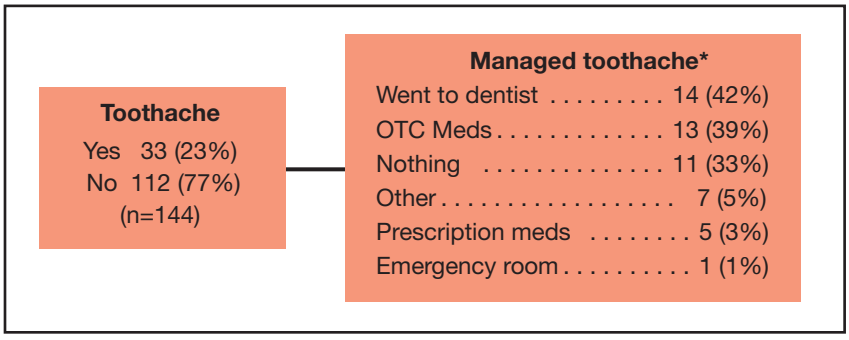


Figure 3. Incidence and management of toothache in last twelve months in veterans ineligible for VADC benefits (n=145)



*Respondents checked all that applied

Frequency and management of toothaches over a twelve-month period for VADC ineligible veterans are shown in Figure 3. Nearly a quarter of veterans reported as having a toothache in the twelve-month period leading up to the study. Less than half (42%) sought dental care, followed closely by those using over the counter medications, or doing nothing at all.

Veteran's perception of oral healthcare

Table II provides an overview of the reported importance of routine dental care and their perception of their own oral health status of VADC ineligible respondents. While the majority (90%) reported routine dental care as important, 25% reported their oral health to be fair or poor. Respondents perceived oral health status as compared to other variables is shown in Table III. Results indicated that lack of dental insurance (p=.161), and self-identified disability ratings (p=.294) were not statistically significant in influencing the respondent's perceived oral health status. Whereas, results did suggest a possible correlation (p=.0.86) between oral health status perception and VADC eligibility status. There was statistical significance in the relationships identified between oral health status perception and lack of dental home (p=.000), a dental visit within the last six months (p=.001), cost inhibiting dental care (p=.000), and whether or not respondents reported having a toothache in the past 12 months (p=.000).

Discussion

Access and funding of oral healthcare

It is well established that there is an access to oral healthcare crisis in the U.S. Determinants of oral health and access to care are significantly influenced by multiple social contexts, however in the veteran population their impact is combined with co-factors including higher rates of mental health disorders, lower education, higher unemployment and homelessness, and a veteran culture that creates additional barriers to access. This study explored veterans' access, funding and attitudes toward oral healthcare.

Respondent demographics in this single state study are representative of national data, making the findings fairly generalizable to the veteran

Table II. Perceived importance of routine dental care and oral health status. Veterans ineligible for VADC benefits (n=145)*

Importance of Routine Dental Care *Likert-scale 1-5: mean 4.52 (±0.84)	**n(%)**
5-Very Important	97 (67%)
4-Somewhat Important	34 (23%)
3-Neutral	9 (6%)
2-Slightly Important	2 (1%)
1-Not Important	3 (2%)
Perceived Oral Health Status *Likert-scale 1-5: mean 3.35(±1.19) *one respondent missing	**n=144 (%)**
5-Excellent	25 (17%)
4-Very Good	49 (34%)
3-Good	34 (24%)
2-Fair	24 (17%)
1-Poor	12 (8%)

Table III. Veteran's perceived oral health status (n=181)

	Positive perception	**Negative perception**	
	n (%)	**n %**	***p*-value**
No dental insurance (n=79)	55 (70%)	24 (30%)	.161
No dental home (n=64)	35 (55%)	29 (45%)	.000*
Dental visit within 6 months (n=111)	96 (86%)	15 (14%)	.001*
Cost preventing seeking dental care (n=60)	32(53%)	28 (47%)	.000*
Self-identified disability rating (n=82)	60 (73%)	22 (27%)	.294
Ineligible for VADC benefits (n=144) *one respondent missing	108 (75%)	36 (25%)	.086
Toothache in last 12 months (n=41)	22 (54%)	19 (46%)	.000*

* Pearson chi-square test p-value <.05 significance

population. Veterans 65 years of age or older and those classified as non-elderly veterans (age 19-64) were relatively equally represented (54% vs. 46%), and is reflective of the rapidly growing, non-elderly segment of the veteran population found in the literature.[32] Nearly half of the respondents should qualify for medical care through the VA healthcare system for their service-connected disability. Findings from this study were divergent from the literature, where only one third of all veterans are reported to receive care through the VA.[27] Based the qualification criteria for VADC services, findings from this study evaluated and confirmed that the majority of veterans are ineligible for VADC benefits.

Identifying whether a veteran has declared service-connected disabilities has significant implications. Veterans may be reluctant to report service-connected disabilities which may ultimately increase their VA eligibility due to the often overlooked and misunderstood unique culture of the military. Military healthcare providers are required to report conditions in the military's best interest over the patient's, creating a distrust of healthcare providers that often carries over into civilian life for veterans.[33] Additionally, this rigid culture frowns on perceptions of being portrayed as weak or inferior, and embraces a warrior mentality that can have significant impact on veterans' accessing care[34] and non-reporting of a service-connected disability has been shown to be more prevalent among uninsured veterans.[35] This culture is concerning considering the wide range of reported service-connected disability ratings in this study that were below the required disability rating for VDAC eligibility. Failure to report service-connected disabilities prevents veterans from being accurately rated for disability and potentially excludes them from qualifying for health and dental benefits through the VA.

Eligibility for insurance benefits does not necessarily translate into better health for this veteran population. Veterans may state that they value and access care services but are more likely to report their health as being fair to poor.[6] Additionally, it has been noted that veterans can be hesitant to seek out care for fear that their providers will report to their employer.[33] The veteran culture and identity might therefore be a significant barrier to accessing oral healthcare. Providers should apply the same principles of cultural competency to veterans as with other cultural groups. Future studies are needed to explore whether or not lack of cultural competence of providers, finances, physical disabilities, or mental illness influence veterans utilization of VADC benefits.[22,25]

Healthy People 2020 equates a visit to the dentist in the previous 12 months as a leading indicator of oral health.[1] While 59% of the

respondents reported having had a dental visit in the previous year, over 40% are not meeting this benchmark for oral health. It is important to understand the potential, perceived and actual barriers for access to oral health care in the veteran population and the impact of the cultural taboo of seeking treatment for health needs should be considered. Veterans have a distinct culture of self-sacrifice that conflicts with putting one's own needs first, which can become a barrier to accessing care, even when there is an acute need.[33,34]

While 20% of veterans qualified for VADC, the majority of those who qualified reported that they did not utilize their benefits. These findings conflict with the majority of veterans who indicated that they perceived the importance of good oral health. However, a significant number of respondents in this study actually rated their own dental health as "fair" or "poor" in spite of reporting having a dental home for routine dental care, a dental visit in the past 3-6 months, and indicated having a preventive appointment for their last dental visit. These findings were consistent with the literature, where veterans may have dental insurance benefits, but are more likely to self-report a status of fair or poor. In this study, perceived oral health status had a statistically significant impact on lack of dental home, having a dental visit within the past six months, financial barriers to dental care, and experiencing a toothache over the last 12 months (Table III).

The cost of oral healthcare was frequently reported as a challenge, with more than half of the VADC ineligible respondents reporting cost as a barrier to accessing any type of oral healthcare. Co-pays and out-of-pocket expenses appear to be barriers for even for those with dental benefits, consistent with the limited literature available on this population. Of the VADC ineligible respondents in this study who indicated that they had dental benefits from sources outside the VA, 20% indicated they had TriCare Retiree Dental Plan, administered by Delta Dental. The TriCare plan has significant limitations for non-preventive procedures, requiring one year of enrollment prior to covering major work (crown and prosthesis), and only pays a percentage of allowable amount determined by the plan, resulting in significant out-of-pocket costs.[36]

Nearly one-third of VADC ineligible respondents reported having Medicaid or Medicare as dental insurance. While Medicare Advantage plans may offer limited dental benefits, it is important to note that the VA does not partner with Medicaid or regular Medicare. This lack of partnership further complicates access to care for non-service related healthcare needs, particularly if these services are provided through the VA. Furthermore, it is generally recognized by the dental community that most private practices do not partner with Medicaid or Medicare dental plans for adult patients due to low reimbursement rates.

Limitations to this study include the potential bias of a self-reporting survey. In addition, the survey questions did not address whether participants had applied to the VA for healthcare benefits, the qualification criteria of veterans who qualified for VADC, or if existing dental insurance benefits were provided by a spouse or parent. Cultural factors that could be impacting veterans' access to care were not addressed in the survey and the convenience sample limited the generalizability of the results. Future research could address these limitations.

Conclusion

Results from this study show that veterans value the importance of oral health. However, strict VADC regulations and cost of care, are the greatest barriers to accessing oral healthcare services for individuals who are ineligible for dental benefits. Further research is needed to impact Veterans Administration policies and decrease oral health disparities in the growing veteran population.

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Research

Radiation Safety Practices of Dental Hygienists in the United States

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Abstract

Purpose: The As Low As Reasonably Achievable (ALARA) principle was developed to promote awareness and minimization of radiation exposure and is supported by radiation control and professional organizations. The purpose of this study was to determine licensed dental hygienists' current radiation safety practices.

Methods: Data were collected with a 22 item, online survey administered to a convenience sample of 1,500 dental hygienists in the United States. Questions focused on respondents' use of the American Dental Association (ADA) radiographic examination selection guidelines, their individual dental practice policies, and hand-held portable x-ray device use and training. Cross tabulations were obtained using logistic regression and general linear models for significance at a 0.05 level.

Results: A response rate of 38% (n = 566) was obtained. A majority of respondents had an associate's degree (62%), were over the age of 55 (41%), and had over 30 years of experience. Respondents with more years of experience were more likely to follow the ADA selection criteria for radiographic need (p=0.0340; SE=0.1093) and respondents with a bachelor's degree or higher were more likely to use techniques to reduce radiation exposure than those with an associate's degree (p=0.0080; SE=0.0169). Respondents who had recently taken dental radiation safety continuing education courses were significantly more likely to wear a clinician lead apron when using a hand-held x-ray device (p=0.0093; M=1.571; SD=1.222).

Conclusion: Dental hygienists with more years of experience, a higher level of education, and recent CE course work were more likely to follow ADA radiographic examination selection guidelines and use appropriate techniques to reduce exposure to ionizing radiation.

Keywords: radiation safety, dental radiography, ALARA principle, selection criteria, dental hygienists

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Introduction

Dental radiographs are an essential component of comprehensive oral care, disease management and diagnosis; however, there are risks associated with the ionizing radiation needed to image teeth and the surrounding bone.[1] Ionizing radiation emitted to produce dental radiographs contains enough energy and has the potential to form unstable atoms and damage DNA;[2,3] therefore, the As Low As Reasonably Achievable (ALARA) principle was developed to promote awareness and minimization of radiation exposure.[1,4-8] Long-term effects of low doses of radiation over time are not well known, but may be associated with embryological defects, low birth-weight babies, cataracts, genetic mutations, salivary gland tumors, and thyroid cancer; thus, making it increasingly important to keep all radiation exposure as low as possible.[2-4] ALARA is supported by numerous radiation control and safety professional organizations, including the American Dental Association (ADA), the National Council on Radiation Protection and Measurements (NCRP), and the International Commission on Radiological Protection (ICRP), and is recommended for adoption and implementation by dental professionals.[2,4,8]

Patient selection

The ADA has provided selection criteria for prescribing and establishing appropriate intervals for dental radiographs as well as the various types of radiographs based on individual needs, giving dental professionals recommendations for application of the ALARA principle.[8,9] ADA selection criteria guidelines recommend the use of assessment findings to determine the appropriate radiographic images based on the individual's disease state, risk factors, age, current patient status

(new or recall), medical and dental histories, and findings from the comprehensive clinical examination.[7-8] Examples of clinical findings used include periodontal involvement and loss of clinical attachment in addition to caries risk status. Periodontal involvement is an important criterion to determine the need for radiographs as the incidence of periodontal disease increases with age.[10] Patients may not always exhibit active periodontal disease clinically; however, selected periapical images (PA's) may determine the extent and prognosis of the disease through radiographic bone level present and the widening of the periodontal ligament space.[8]

Radiation safety

ADA radiographic selection criteria guidelines recommend use of digital image receptors with the ability to limit radiation exposure.[6,8] Study results by Berkhout et al. identified up to 55% reduction in radiation exposure when comparing digital imaging to E-speed films.[11] Direct digital image receptors (wired sensors) may be considered more ideal in terms of radiation safety as they have a narrower dynamic range as compared to the wider range of photostimulable phosphor (PSP) plates.[11-14] It is important to maintain a goal of producing diagnostic radiographs while decreasing patient and clinician exposure to ionizing radiation.

Other safety measures to reduce radiation exposure include equipment factors, such as the shape and length of the position indicating device (PID) on the x-ray tubehead. Rectangular PIDs minimize radiation exposure compared to round; longer PIDs reduce radiation compared to short PIDs.[6,8,15] Due to the potential of scatter radiation exposure for dental professionals, all safety measures should be taken to minimize operator radiation exposure.[16] Defective x-ray machines may result in drifting of the PID, increasing the need for retakes. Additionally, x-ray equipment must be checked periodically to ensure proper functioning as required by state and federal law.[6] Operators should never hold the x-ray unit or have their hand in the path of the primary x-ray beam during an exposure.[15]

Key safety features also include exposure factors such as: milliamperage (mA), exposure time, and kilovoltage (kV) settings. These exposure factors should be modified depending on varying bone densities within the oral cavity. Higher exposure settings are needed to image areas with greater bone density, while lower exposure settings image less dense areas.[17] When exposing pediatric patients to radiation, it is important to consider that bone structures of children under twelve years old are typically less dense than those of adults;[8] therefore, exposure times should be reduced by approximately 30%.[18] Children may also be more susceptible to radiation injury compared to adults because of their younger, more rapidly dividing cells.[7,19] If variable exposure settings for kVp and mA are available on the unit, the dental professional should ensure that the appropriate settings are used based on patient size and area of the oral cavity being exposed. In the absence of variable kVp and mA settings, exposure time may need to be adjusted to compensate for patient size and the area being irradiated.

Lead or lead equivalent aprons are also important safety measures as they protect the patient from scatter radiation that might impact critical organs and tissues. A thyroid collar should be provided in addition to lead aprons for thyroid gland protection and should be used for all children, women of childbearing age, and pregnant women.[7,8,15-16,20-21] Thyroid collars have been shown to reduce exposure up to 33% in children and 63% in adults.[22-23] The National Council on Radiation Protection and Measurements (NCRPM) states that the patient lead or lead equivalent aprons are not required when all the following safety measures are adhered to: use of rectangular collimation, fast image receptors, and patient selection criteria guidelines.[24] Furthermore, the NCRPM states that thyroid collars should be used on all patient exposures except when there is potential of interfering with the examination, which most commonly occurs during the exposure of a panoramic image.[21,24]

Radiographs during pregnancy

Controversy exists on risks versus benefits associated with exposure of dental radiographs on pregnant women. Current ADA guidelines reference the American College of Obstetricians and Gynecologists (ACOG) in expressing that exposing pregnant patients to necessary dental radiographs during any stage of pregnancy is considered to be safe as long as abdominal and thyroid shielding are used.[25] ADA selection criteria guidelines should be referenced and used for determining the type of radiographs for the identified condition and whether dental x-rays are necessary and beneficial for the recommended treatment. Dental professionals should also use digital imaging and fast image receptors to further reduce exposure to radiation in pregnant patients. According to Matteson et al., there is no evidence to support excluding x-rays due to pregnancy;[26] however, no studies have been conducted due to safety issues in testing pregnant patients.

Radiographic techniques and handheld devices

Proper radiographic technique is also important in reducing radiation to eliminate retake exposures.[20] The paralleling technique should be attempted first, as it is considered the gold standard for acquiring periapical images while reducing radiation exposure.[20,24] An alternative approach, the bisecting

angle technique, may result in image distortion and increased radiation exposure of the thyroid gland and lens of the eye due to the increased vertical angulation of the tubehead.[20,27] To prevent retakes, clinicians should decide on the most ideal technique based on the patient's unique characteristics.

Handheld radiographic devices, such as the NOMAD™ and Nomad Pro 2™ (KavoKerr; Charlotte, NC, USA), are frequently being found in traditional as well as alternative practice settings due to their ease of use and portability.[28] These handheld devices are often used when a wall-mounted x-ray machine is not available such as nursing or private home settings or when the patient cannot be moved.[29] Practitioners should ensure that the handheld device has been certified by the Food and Drug Administration (FDA) and that all the manufacturer safety precautions are being followed.[30] FDA compliance inspections must be performed on all dental x-ray machines within one year of purchase.[30] Safety requirements include inherent tubehead shielding, additional shielding around the PID, and a leaded acrylic external backscatter ring shield.[31] In general, scatter radiation is reduced with handheld radiographic devices because a smaller area is exposed to radiation; however, the backscatter ring shield must also be affixed to the device for optimal operator protection.[8]

Manufacturers of the NOMAD™ handheld radiographic devices advise specific instructions in regards to optimal operator protection from backscatter radiation exposure. Operators must stand within the significant zone of occupancy immediately behind the device shield, ensure the backscatter ring shield is placed at the outer end of the PID, and keep the PID as close to the patient's face as possible.[8,31] Radiation protection is considered to be minimized when the device is not held at mid-torso, with the PID parallel to the floor;[31] any operation outside of the protection zone could result in backscatter radiation exposure.[31] Protective thyroid collars and lead aprons are recommended for clinicians when operating handheld radiographic devices.[8, 31,32]

Regular training is important for ongoing reinforcement of radiation safety practices.[8] In general, research suggests that up to 44% of knowledge is lost within six to twelve months after information has been learned;[34] therefore, clinicians may benefit from review of the safety standards and advancements in radiation practice. Little is known about the radiation safety behaviors of dental hygienists. The purpose of this study was to determine the radiation safety methods currently being implemented by practicing dental hygienists in the United States (U.S.).

Methods

The Institutional Review Board of Old Dominion University granted approval for this investigator-designed survey that utilized a convenience sample of dental hygienists in the U.S. who were subscribers of an online professional journal (*Dimensions of Dental Hygiene*, Belmont Publications, Santa Ana, CA). An invitation to participate in the survey was emailed by the publisher to the first 1,500 subscribers; Qualtrics (Provo, Utah) administered the online survey. A cover letter was included with the survey explaining the purpose, instructions for survey completion, inclusion/exclusion criteria, and references to contact for questions; survey submission was acknowledged as consent to participate. Inclusion criteria consisted of dental hygienists currently practicing in the U.S. who exposed radiographs. Prior to beginning the study, the survey was pilot-tested for content and validity on 29 dental hygiene faculty members at Old Dominion University.

The survey contained six close-ended demographic questions related to education, number of semesters devoted to radiology curriculum, primary work setting, age, years of experience, and location of current practice. The remaining sixteen questions included use of ADA selection criteria guidelines, policies implemented by practice settings, and use of handheld radiographic devices. Questions regarding the ADA selection criteria guidelines and image receptor use had responses of yes or no for each question item. Respondents answered items regarding their current radiographic technique with a 7-point Likert scale with choices ranging from *strongly agree* to *strongly disagree*. Respondents were asked to answer yes or no on whether they ever held the PID in place during an exposure. Those who said yes were asked to provide how many times they did so in the last 10 years and an explanation of the listed situations. Questions regarding the use of a handheld radiographic device were presented as yes or no questions. Respondents were asked to explain whether they aimed the handheld device at their mid-torso level for all exposures. Questions describing individual practice policies were presented in short answer format.

The survey was made available for forty-seven days. Non-respondents were sent email reminders every two weeks. Responses were reported and analyzed in group format to preserve respondents' identities. Statistical analysis was performed using Statistical Analysis Software (SAS®; Cary, NC) version 9.4.[35] Data were analyzed for distribution differences and statistical significance using descriptive statistics, logistic regression models, and general linear models.

Results

A total of 566 dental hygienists (n=566) met the inclusion criteria for a response rate of 38%. Over one-third (38%) of the respondents had been practicing dental hygiene for 31 or more years. Sample demographics are shown in Table I. A majority of respondents reported always using a patient lead apron (89%) and including thyroid collars for intraoral exposures (78%). Nearly three-quarters of the respondents (72%) indicated using short PIDs for radiographic procedures and only 4% of respondents reported using a rectangular PID. Respondents reported using the following types of image receptors: D speed film (7%), E speed film (6%), F speed film (7%), PSP plate (24%), and direct digital image receptor (79%). Over half of the respondents (52%) admitted to holding the PID in place during an exposure. Selected explanations of situations for holding the PID in place are shown in Table II.

Table I. Sample demographics (n=566)

Demographic	n	%
Level of education		
Associate's degree	351	62%
Bachelor's degree or higher	215	38%
Number of semesters of radiology coursework		
One or less	238	42%
Two	240	42%
Three	34	6%
Four	54	10%
Age		
20-24 years	13	2%
25-34 years	102	18%
35-44 years	87	16%
45-54 years	131	23%
55 years and above	233	41%
Years of clinical experience		
0-10 years	176	31%
11-20 years	76	13%
21-30 years	99	18%
31+ years	215	38%
Region of the United States		
West (Alaska, California, Colorado, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming, Arizona, New Mexico)	120	21%
Central (North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Wisconsin, Illinois, Indiana, Michigan, Ohio, Oklahoma, Texas)	191	34%
East (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Louisiana, Mississippi, Maryland, Maine, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Vermont, West Virginia)	255	45%

Table II. Selected situations for holding the PID during an exposure

Children
Patient unable to sit still
Gag reflex
Patient keeps pushing sensor out
Fearful patient
Patient Characteristics
Severe gag reflex
Unable to close/ cannot hold jaw still
Psychological issues
Geriatric patients
Small mouths
Special needs patients
Nervous or anxious patients
Large tori
Wisdom teeth
Edentulous
Equipment Characteristics
Drifting tubehead
Lack of stabilization
Ease of Capturing Image
No other way to get the image
Difficulty with obtaining correct positioning
Steady the sensor
Difficulties with image receptor holding device
Needed for correct angulation
Extremely challenging images
Emergency situation

Regarding radiographic imaging techniques, 61% of the respondents reported they *somewhat agreed* to *strongly agreed* to using the bisecting angle technique as the first choice for obtaining periapical images (61%), while 56% reported they *somewhat agreed* to *strongly agreed* to using the paralleling technique first. The vast majority of respondents knew that exposure settings should be changed for pediatric patients (90%), and three-fourths believed settings should be altered depending on the area imaged (Table III).

Table III. Criteria used to determine radiographic technique

Radiographic Technique	Somewhat agree – Strongly agree n(%)	Neither agree nor disagree n(%)	Somewhat disagree – Strongly disagree n(%)
My first choice when acquiring periapical x-rays is to put the sensor/film far away from the tooth (paralleling technique	322 (56%)	97 (17%)	147 (27%)
My first choice when acquiring periapical x-rays is to put the sensor/film as close to the tooth as possible (bisecting angle technique).	345 (61%)	101 (18%)	120 (21%)
My decision to use the paralleling technique or bisecting angle technique depends on the unique characteristics of the patient.	477 (85%)	53 (9%)	36 (6%)
Exposure settings should be altered depending on the area imaged.	411 (72%)	99 (18%)	56 (10%)
Exposure settings should be altered for child patients.	513 (90%)	37 (6%)	16 (4%)
Exposure settings for digital and film vary.	486 (86%)	58 (10%)	22 (4%)
Intervals for exposing radiographs depend on the patient's disease state and radiation exposure history.	490 (86%)	37 (7%)	39 (7%)

Respondents provided information regarding their practice policies on the radiographic exposure of pregnant patients. Ten respondents reported their practice does not see pregnant patients and were excluded from the statistical analysis. Of the remaining respondents (n=556), 14% had practice policies prohibiting exposure of radiographs during pregnancy, while 50% exposed radiographs on pregnant patients only in cases of pain or emergency. Twelve percent of respondents reported their practice took dental radiographs depending on the patient's trimester, and 8% required written permission from the patient's obstetrician. Two respondents indicated that while they knew that radiographs were safe to take on pregnant patients provided ALARA principles were followed, their supervising dentist did not allow for the radiographs to be taken.

Regarding the use of handheld radiographic devices,12% (n=67) of respondents indicated using a portable device with 57% reporting that they had received training prior to exposing patients. Respondents reported the following safety measures: kept the PID as close to the patient's face as possible (92%), used an external shield on the device's PID (92%), wore a dosimeter badge (22%), and wore a clinician lead apron (21%). Less than half (38%) of the users reported holding the device at mid-torso level for all exposures.

Level of education and the criteria used to determine radiographic need were analyzed and statistically significant relationships in the criteria used to determine need for radiographs based on years of experience were found (p=0.0340). Further analysis identified a statistically significant relationship between a higher level of education (bachelor's degree or higher) and the use of periodontal involvement in particular as a criterion for determining radiographic needs (p=0.0462). Criteria used to determine the need for radiographs and level of education are shown in Table IV.

Safe radiographic techniques and level of education were also analyzed (Table V). Data revealed a significant relationship (p=0.0080) between level of education and radiographic technique used, suggesting clinicians with a bachelor's degree or higher were more likely to use safer techniques as compared to those holding associate's degrees. Statistically significant relationships were found between level of education and the utilization of the paralleling technique as the first choice over the bisecting angle technique (p=0.0052), altering exposure settings depending on the area imaged (p=0.0065), and reducing exposure settings for pediatric patients (p=0.0347).

Forty-one percent of the respondents indicated that they had not completed any continuing education (CE) in dental radiation safety in the last five years, while 34% had taken one course and 25% had taken two or more courses. Frequency of CE courses was analyzed with the PID characteristics used by the respondents. Rectangular PIDs were used more frequently by respondents who had participated in CE courses over the past five years (p=0.0008). Use of clinician lead aprons while using handheld radiographic devices was also shown to be significantly higher based on the number of radiation CE courses taken in the last five years (p=0.0093). Results revealed the chances of using a handheld radiographic device were higher with a lower age range; 23% of respondents using portable devices were between 20-24 years of age (p=0.0025).

Discussion

Dental hygienists should be knowledgeable about implementing safe radiation practices for all patients requiring radiographic examinations. Findings from this study indicated that participants practiced safer radiographic techniques with more years of experience along with higher levels of education. Results from the current study may support the need for more continuing education courses in

Table IV. Criteria used to determine need for radiographs and level of education

	Associate's degree n=351	Bachelor's degree n=215	*p*-value
Suspected caries	**99%**	**99.5%**	
Yes	348	214	0.5913
No	3	1	
Periodontal involvement	**97%**	**99.5%**	
Yes	341	214	0.0462
No	10	1	
History of previous radiographs	**95%**	**93.9%**	
Yes	335	202	0.4358
No	16	13	
Defective restorations	**90.9%**	**94.4%**	
Yes	319	203	0.1274
No	32	12	
Impaction/missing teeth	**96%**	**97.2%**	
Yes	337	209	0.4537
No	14	6	
Growth abnormality/delayed eruption	**97.2%**	**96.7%**	
Yes	341	208	0.7832
No	10	7	
Suspected pathology	**95.2%**	**97.2%**	
Yes	334	209	0.2300
No	17	6	
Unexplained sensitivity/pain	**95.7%**	**97.7%**	
Yes	336	210	0.2231
No	15	5	
Third party reimbursement	**31%**	**29%**	
Yes	110	63	0.6097
No	241	125	

radiographic technique and safety practices in addition to providing areas of content to be addressed.

Equipment Factors

A majority of respondents reported using direct digital image receptors, which have a narrower dynamic range than indirect receptors. Direct digital image receptors are also capable of alerting the operator when exposure settings are outside of the narrow range thus requiring more precise exposure settings and less radiation.[29] While the majority of respondents used direct digital image receptors, most were not adjusting the settings to reduce the exposure time, suggesting a need for more education on the dynamic range of direct digital receptors.

Eleven percent of participants reported that they were not using a patient lead apron for all radiographic exposures which may be due to meeting all the NCRP requirements including rectangular collimation, fast image receptors, and following the ADA selection criteria guidelines.[24] Rectangular collimation and long PIDs are recommended to decrease the area of the primary x-ray beam and increase the distance from the radiation source in order to reduce the area exposed and minimize scatter radiation.[8] Results indicated that about one-fourth of respondents did not use thyroid protection during intraoral exposures which is concerning due to the scatter radiation to the thyroid gland that can result when a circular PID is used. Thyroid collars should be used for all intraoral exposures in the absence of rectangular collimation, fast speed receptors and the use of the paralleling technique.[21,24]

Radiographic Techniques

More respondents used the bisecting angle technique as compared to the paralleling technique, suggesting a higher chance of retake exposures as the bisecting angle technique is less precise compared to the paralleling technique.[20,24] The bisecting angle technique also directs the beam toward the thyroid when positioning for the maxillary arch. Using the appropriate radiographic technique is key in reducing patient radiation exposure.

Outside of the radiographic technique utilized, the ALARA principle should be followed to minimize radiation exposure. However, more than one-fourth of respondents indicated exposing radiographs based on third party reimbursement. Determination of when to take dental radiographs should be made based on ALARA principles and the patient's current oral condition, not based on the frequency of a third-party payment for the diagnostic procedure.

Just over half of respondents reported holding the PID in place during an exposure; most frequently while exposing radiographs

Table V. Radiographic technique and level of education

Radiographic Technique	Level of Education	Mean	SD*	*p*-value**
My first choice when acquiring periapical x-rays is to put the sensor/film far away from the tooth (paralleling technique).	Associate's degree	4.538	1.943	0.0052
	Bachelor's degree or higher	4.995	1.768	
My first choice when acquiring periapical x-rays is to put the sensor/film as close to the tooth as possible (bisecting angle technique).	Associate's degree	3.171	1.747	0.8258
	Bachelor's degree or higher	3.205	1.802	
My decision to use the paralleling technique or bisecting angle technique depends on the unique characteristics of the patient.	Associate's degree	5.832	1.383	0.2957
	Bachelor's degree or higher	5.958	1.409	
Exposure settings should be altered depending on the area imaged.	Associate's degree	5.222	1.468	0.0065
	Bachelor's degree or higher	5.563	1.392	
Exposure settings should be altered for child patients.	Associate's degree	6.074	1.131	0.0347
	Bachelor's degree or higher	6.270	0.953	
Exposure settings for digital and film vary.	Associate's degree	6.077	1.211	0.6755
	Bachelor's degree or higher	6.033	1.243	
Intervals for exposing radiographs depend on the patient's disease state and radiation exposure history.	Associate's degree	5.909	1.399	0.6510
	Bachelor's degree or higher	5.963	1.339	

*Standard deviation **Level of significance: $p=0.05$.

on pediatric patients. In situations where the child is unable to sit still or occlude on the biteblock, parents and guardians should be asked to hold the image receptor for the child rather than the clinician.

Another reason for holding the PID in place was in cases when the tubehead drifted; however, x-ray machines should require immediate inspection if they are unstable or drifting.[15] In addition, operators should be familiar with their state board regulations regarding the frequency of required inspections, as they vary per state. For example, dental x-ray machines are required to be inspected every 3 years in Virginia, every 4 years in Texas, and every 5 years in Utah.[30,36-37] Inspection of the machine may help prevent drifting of the tubehead.

Handheld Radiographic Devices

In general, younger respondents reported use of handheld radiographic devices more frequently, which may be associated with technologically driven devices, preferred by younger dental professionals or due to higher numbers working with homebound patients. However, it was of concern that 43% of respondents using handheld radiographic devices had not received training prior to use on patients and less than half of respondents reported holding the device at mid-torso level. Handheld radiographic devices that are not held at mid-torso level, such as when exposing periapical images with increased vertical angulation, can generate scatter radiation beyond the backscatter ring shield creating increased exposure for the operator. Respondents were either unaware of the importance of the mid-torso guideline or they stated that it was not possible to hold the device at this position for all exposures. Operators cited making exceptions to the mid-torso guideline depending on the difficulty of the patient. Modified positioning techniques such as moving the chin up or down, using image receptor holders, and the paralleling technique should be used to minimize radiation exposure to both the patient and the operator. Increasing the vertical angulation for periapical images can help ensure that the operator is within the significant zone of protection from backscatter radiation exposure.

Manufacturer safety guidelines and Danforth et al. concur regarding use of an operator lead apron and thyroid collar if the handheld devices are being operated outside of what is considered to be the protection zone.[8,28,31] Respondents in this study reported that they were not following all the recommended safety measures and, in those cases, should be wearing operator lead aprons as a safety precaution. With the use of handheld radiographic devices increasing,[31] operators should be required to have proof of training prior to use, similar to the guidelines outlined by the European Academy of Dento Maxillo Facial Radiology.[39]

Impact of Continuing Education Courses

Results suggest that CE courses in dental radiation safety had a positive impact on the safety of radiation equipment and the use of protective measures, such as use of rectangular

PIDs and thyroid collars. While dental hygienists would benefit from CE courses in dental radiation safety; only about half of respondents had taken at least one dental radiation safety CE course over the past five years.

Responses regarding radiation exposure and pregnant patients also demonstrate the need for regular CE and up to date practice policies. The ACOG states pregnant patients may be exposed to dental radiation during any stage of pregnancy as long as a need exists and a lead apron and thyroid collar are used.[25] Responses indicated that many dental hygienists were not following ACOG guidelines. Only 1% of all survey respondents were following current recommendations; this small percentage of respondents indicated knowing that radiographs could safely be exposed on pregnant patients as long as the ADA selection criteria guidelines were followed. Half of the respondents were following old recommendations that do not allow for radiographs unless there is an absolute need.[38] Regular CE on radiation safety would be beneficial to keep dental professionals up to date on technological advancements and safety regulations within oral radiology.

Limitations

Limitations to the current study include the convenience sample and the relatively low response rate making it difficult to generalize the results. In addition, there were significantly more respondents from the Eastern (45%) than the Central (34%) and Western (21%) regions of the U.S. Radiographic techniques and safety regulations may vary in different regions of the country. The sample demographics may not be a representative cross-section of the dental hygiene U.S. population since a majority of the respondents had been in practice for at least 31 years, and a majority were aged 55 years or older. The number of radiology courses taken while in dental hygiene school may not have had a direct relationship to the level of radiation safety actually taught and may be a limiting factor in the findings of this study. Future studies may examine the specific radiography course requirements to compare the level of radiation safety taught.

Conclusion

Dental hygienists with more years of experience, a higher level of education, and recent CE course work were more likely to follow ADA radiographic examination selection guidelines and use appropriate radiographic techniques to reduce exposure to ionizing radiation. Future studies are needed to determine effective approaches to improving dental radiation safety.

Content for continuing education courses on radiation safety techniques should be developed to address the technological advances in dental radiography.

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Research

Experience and attitudes regarding requirements for magnification and coaxial illumination among dental hygiene students

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Abstract

Purpose: Dental professionals are at elevated risks for the development of musculoskeletal disorders due to the occupational demands of static postures and precision movements required for instrumentation. The purpose of this study was to evaluate the experiences and attitudes regarding the requirements of purchasing and utilizing magnification loupes and coaxial illumination for patient care among dental hygiene students with the state of Ohio.

Methods: A cross-sectional, web-based, anonymous survey was sent via the dental hygiene program directors to dental hygiene students in the state of Ohio. Descriptive statistics were used to describe the dental hygiene students' experience with magnification loupes and coaxial illumination.

Results: A total of 123 students (n=123) participated in the study representing a response rate of 36.2%. Most respondents used magnification loupes (89.4%, n=110) and coaxial illumination (84.5%, n=105) while delivering patient care. Respondents who were required to purchase magnification loupes were more likely to feel that dental hygiene students ($X^2(1)=37.735$, $p<.001$) and dental hygiene faculty ($X^2(1)=38.256$, $p<.001$) should be required to purchase magnification loupes. Respondents who were not required to purchase their magnification loupes felt that loupes increased the accuracy of assessments and procedures ($U=1376.00$, $p<.01$) and increased the efficiency of providing care ($U=1327.00$, $p<.001$). Students who were required to purchase coaxial illumination were more likely to feel that dental hygiene students ($X^2(1)=10.809$, $p<.001$) and dental hygiene faculty ($X^2(1)=6.796$, $p<.01$) should be required to purchase illumination.

Conclusion: When considering student purchasing requirements for magnification loupes and coaxial illumination, the attitudes of dental hygiene students towards their utilization and benefits should be considered.

Keywords: magnification loupes, coaxial illumination, musculoskeletal disorders, dental hygiene education, dental hygiene students

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Introduction

Dental professionals are at elevated risks for the development of musculoskeletal disorders due to the occupational demands of static postures and precision movements required for instrumentation.[1-7] Surveys conducted among dental professionals have shown that a majority of clinicians, (74%) reported musculoskeletal pain,[3] particularly in the shoulders, neck, upper back, lower back, and wrists.[8,9] In populations of dental hygiene professionals, the main cause of the pain was identified as the forward flexion of the neck and anterior carriage of the head.[9-11] However, musculoskeletal pain has also been identified during entry-level clinical training by dental hygiene students[5,12] and may serve a precursor to the development of musculoskeletal disorders as practicing clinicians.[11-13]

Ergonomics is defined as the science of designing equipment and maximizing working spaces to increase productivity and minimize operator fatigue and pain.[14,15] Magnification loupes have been shown to provide both positive and negative ergonomic aspects for clinicians.[1,5,10,11,16] More acceptable postures can result with the proper use of magnification loupes; however formative feedback from faculty also plays a role in helping students achieve those acceptable postures.[1,17,18] Although students may report self-perceived improvement in

postures using indirect vision with magnification, accuracy and efficiency do not necessarily change with the use of magnification.[19] To supplement the beneficial effects of magnification, the use of coaxial illumination, or light sources aligned with the sight line, may be associated with improved postures and clinical benefits.[20-23] Designed to supplement the overhead dental operatory light, headlights using light-emitting diode (LED) technology provide shadow-free illumination using corded or cordless batteries. Coaxial illumination provides shadow-free lighting to the working area in alignment with the magnification loupes to the working area. Used in conjunction with magnification loupes, coaxial illumination provides operators with ergonomic benefits by eliminating the need for overhead light adjustment.[20,22] The combination of LED light and low-powered magnification (2.5 power) has also been shown to enhance caries detection in primary dentition.[24] Although ocular hazards may exist with the use of LED lights, most headlight manufacturers use LED beams within the safe zone spectrum and settings are recommended at minimum levels to reduce glare and maintain optimal visual acuity.[25]

Experiences and opinions regarding the use of magnification loupes vary among dental professional students and practicing clinicians. However, trends towards requiring the use of magnification loupes in dental hygiene education programs are increasing. A national survey conducted in 2012 indicated that one-fourth of dental hygiene programs required students to purchase magnification loupes and less than ten percent of dental hygiene programs mandated that their clinical faculty purchase magnification loupes.[26] Within five years a little less than one-half (44%) of dental hygiene programs required students to purchase magnification loupes. However, only 9% of the programs mandated students to purchase coaxial illumination.[23] In spite of the increasing trend of requiring students to purchase of magnification loupes, no studies have been reported in the literature regarding the attitudes of dental hygiene students towards the use of magnification loupes and coaxial illumination. The purpose of this study was to evaluate the experiences and attitudes regarding the requirements of purchasing and utilizing magnification loupes and coaxial illumination for patient care among dental hygiene students with the state of Ohio.

Methods

This study involved a cross-sectional, web-based, anonymous survey of dental hygiene students in the state of Ohio and was determined to be exempt from Institutional Board Review from The Ohio State University (2015EO344). E-mails were sent to the twelve dental hygiene program directors in the state of Ohio to invite all dental hygiene students enrolled in their entry-level programs to participate in the study. Informed consent was implied through completion of the survey.

The 25 item survey was originally created with questions patterned after two existing surveys.[27,28] Questions included demographic information; respondents' experience with magnification loupes and coaxial illumination; and attitudes about program purchasing and utilization requirements for magnification loupes and coaxial illumination. The majority of the items required yes/no responses and Likert-style responses ranging from 1- strongly disagree to 5- strongly agree. Two open ended questions required responses from participants who did not use magnification loupes and/or coaxial illumination.

A panel of 4 dental hygiene faculty experts reviewed the questions for content validity. The survey was pilot tested on 30 dental hygiene students for validity and reliability. Following revisions, the survey was finalized by the panel of dental hygiene experts.

Qualtrics web-based survey software (Provo, UT, USA) was used to construct and administer the survey. The invitation e-mail was sent to the 12 dental hygiene program directors in Ohio to inform them of the study followed by an additional e-mail was sent for the program directors to directly to the dental hygiene students enrolled in their programs. After 2-weeks, a reminder e-mail and separate forwarding e-mail was sent to the program directors. The survey was closed after a total time of 28 days.

Data were analyzed using SPSS Version 25 (IBM; Armonk, New York, USA). Descriptive statistics were used to describe the dental hygiene students' experience with magnification loupes and coaxial illumination. Chi-square analysis and Mann Whitney *U*-tests were used to explore the associations between requirements of magnification loupes and coaxial illumination and experience and attitudes with the magnification loupes and coaxial illumination.

Results

Eight of the twelve dental hygiene program directors in Ohio agreed to invite their enrolled dental hygiene students to participate in the survey. While the program directors were not asked how many students were e-mailed the survey, it was estimated that approximately 42 students were enrolled in each of the eight programs totaling 340 students (n=340). A total of 123 students (n=123) participated in the study

representing a response rate of 36.2%. Nearly three-quarters of the respondents (72%) were enrolled in an associate degree program, while the remaining 28% were enrolled in a baccalaureate degree program. A little more than one-half (55%) were in were in their 1st year and 45% were in their 2nd year of study. Respondent demographics are shown in Table I.

Table I. Demographic characteristics of the respondents (n=123)

College structure	Associate degree program 72.4% (n=89)		Baccalaureate degree program 27.6% (n=34)	
Year in program	1st year 55.3% (n=68)		2nd year 44.7% (n=55)	
Gender	Female 96.7% (n=119)	Male 1.6% (n=2)		Declined to state 1.6% (n=2)
Age group	20-29 years 75.6% (n=91)	30-39 years 17.1% (n=23)	40-49 years 4.9% (n=6)	Other 2.4% (n=3)

The first aim of the study was to determine the experiences of dental hygiene students using magnification loupes and coaxial illumination for patient care (Table II & III). A majority of respondents used magnification loupes when providing patient care (89.4%, n=110). Of the minority who were not using magnification loupes (10.6%, n=13) the following reasons were cited: cost, possible dependence on loupes, and possible effects on vision.

For the respondents using loupes, the following beliefs/ attitudes were identified as consequences to not using magnification loupes: compromised ergonomics (52.0%, n=64), compromised patient care (32.5%, n=40), inability to provide patient care (3.3%, n=4)). A little more than half of the participants (56.1%, n=69) were required to purchase their magnification loupes, felt that dental hygiene instructors should be required to purchase loupes (53.7%, n=66), and believed that magnification loupes should be purchased by the time of their preclinical instruction course (52.8%, n=68).

Most respondents used coaxial illumination while delivering patient care (84.5%, n=105). Of those not using coaxial illumination (13.8%, n=17), cost, inconvenience with the cord, and lack of perceived need were given as reasons for not using illumination. Respondents using coaxial illumination identified that barriers to coaxial illumination use would lead to feeling uncomfortable while providing patient care (33.1%, n=53), compromised ergonomics (19.5%, n=24), inability to provide patient care (2.4%, n=3). Nearly one-fifth (19.5%, n=24) of the participants felt that a barrier to using coaxial illumination would not result in any differences in in the provision of patient care. A majority of the participants (82.9%, n=102) were not required to purchase coaxial illumination, did not feel that students should be required to purchase coaxial illumination (49.6%, n=61), and did not feel that dental hygiene instructors should be required to purchase coaxial illumination (66.7%, n=82). Respondents' magnification loupe and coaxial illumination experiences and attitudes are shown in Tables II and III.

The second aim of the study was to explore the attitudes of dental hygiene students towards the use of magnification based on the dental hygiene program requirement to purchase magnification loupes (Table IV). Chi-square tests of independence were calculated comparing the student requirement for magnification loupes and wearing loupes while providing patient care, attitudes about whether magnification loupes should be required for dental hygiene students, and attitudes about whether magnification loupes should be required for dental hygiene instructors. Significant interactions were identified. Dental hygiene students who were required to purchase magnification loupes were more likely to wear loupes when providing patient care ($X^2(1)=18.574$, $p<.001$); more likely to feel that dental hygiene students should be required to purchase magnification loupes ($X^2(1)=37.735$, $p<.001$); and more likely to feel that dental hygiene instructors should also be required to purchase magnification loupes ($X^2(1)=38.256$, $p<.001$).

Mann-Whitney *U*-tests were used to examine the relationships between the student requirements to purchase magnification loupes and student attitudes of whether magnification loupes increase the use of proper ergonomics, increase the accuracy of assessments and procedures, and increase the efficiency of providing care (Table V). No significant differences were found in regards to whether student attitudes towards magnification loupes increased the use of proper ergonomics among students who were required or not required to purchase magnification loupes ($U=1780.00$, $p>.05$). Dental hygiene students who were not required to purchase magnification loupes but used them in the clinic felt that magnification loupes increased the accuracy of assessments and procedures (M place=71.02; $U=1376.00$, $p<.01$) and increased the efficiency of providing care (M place=71.93; $U=13277.00$, $p<.01$).

The third aim of the study was to evaluate the attitudes of dental hygiene students regard-

Table II. Respondents experiences and attitudes towards magnification loupes (n=123)

Questions for Magnification Loupes					
Do you currently use magnification loupes while providing patient care?	Yes 89.4% (n=110)		No 10.6% (n=13)		
If magnification loupes is not used, why not?	Too expensive (n=7)	Concerns about dependence on magnification (n=2)	Concerns about effects on vision (n=1)	Plan to purchase (n=2)	
If yes, which best describes how you would feel if you were unable to use magnification during patient care?	I would feel comfortable providing patient care 4.1% (n=5)	I would feel I was compromising my ergonomics 52.0% (n=64)	I would feel unsure about providing adequate patient care 32.5% (n=40)	I would feel unable to provide care 3.3% (n=4)	No answer 8.1% (n=10)
Does your school require the students to purchase magnification loupes for patient care?	Yes 56.1% (n=69)		No 43.9% (n=54)		
Do you feel that dental and dental hygiene students should be required to use magnification while providing patient care?	Yes 65.0% (n=80)		No 35.0% (n=43)		
If yes, how soon should magnification loupes be purchased and worn?	During pre-clinical instruction 52.8% (n=68)	At the start of patient care experiences 7.3% (n=9)	At the end of first year of patient care experiences 4.9% (n=6)	No answer 35.0% (n=43)	
Do you feel that dental and dental hygiene clinical faculty members should be required to use magnification while providing patient care?	Yes 53.7% (n=66)		No 43.6% (n=57)		
Using magnification loupes increases the use of proper ergonomics by the practitioner.	Strongly agree 63.4% (n=78)	Agree 34.1% (n=42)	Neutral 1.6% (n=2)	Disagree 0.0% (n=0)	No answer 0.8% (n=1)
Using magnification loupes enhances the accuracy of assessments and procedures.	Strongly agree 67.5% (n=83)	Agree 26.8% (n=33)	Neutral 4.9% (n=6)	Disagree 0.8% (n=1)	No answer 0.0% (n=0)
Using magnification loupes improves the efficiency of providing patient care.	Strongly agree 61.0% (n=75)	Agree 30.1% (n=37)	Neutral 7.3% (n=9)	Disagree 1.6% (n=2)	No answer 0.0% (n=0)

ing illumination based on the requirement to purchase coaxial illumination (Table VI). Chi-square tests of independence were calculated comparing the student requirement for coaxial illumination and wearing coaxial illumination while providing patient care, attitudes about whether coaxial illumination should be required for dental hygiene students, and attitudes about whether coaxial illumination should be required for dental hygiene instructors. No significant interaction was found between dental hygiene students who were required to purchase coaxial illumination and dental hygiene students using coaxial illumination when providing patient care ($X^2(1)=1.272$, $p>.05$). Dental hygiene students who were required to purchase coaxial illumination themselves were more likely to feel that dental hygiene students should be required to purchase coaxial illumination ($X^2(1)=10.809$, $p<.001$) and were more likely to feel that dental hygiene instructors should also be required to purchase coaxial illumination ($X^2(1)=6.796$, $p<.01$).

Mann-Whitney *U*-tests were used to examine the relationships between the student requirements to purchase coaxial illumination and attitudes of whether coaxial illumination increased the use of proper ergonomics, increased accuracy of assessments and procedures, and increased the efficiency of providing care (Table VII). No significant differences were found in the attitudes of whether coaxial illumination increased the use of proper ergonomics ($U=952.50$, $p>.05$), increased accuracy of assessments and procedures ($U=898.50$, $p>.05$), and increased the efficiency of providing care ($U=950.50$, $p>.05$) among dental hygiene

Table III. Respondents experiences and attitudes towards coaxial illumination (n-123)

Questions for coaxial illumination					
Do you use a headlight (coaxial illumination) while providing patient care?	Yes 84.5% (n=105)	No 13.8% (n=17)			No answer 0.8% (n=1)
If a headlight (coaxial illumination) is not used, why not?	Too expensive (n=10)	Not needed for patient care (n=1)	Inconvenience of light/wire (n=2)		Other (n=5)
If yes, which best describes how you would feel if you were unable to use a headlight during patient care?	I would feel comfortable providing patient care 19.5% (n=24)	I would feel I was compromising my ergonomics 19.5% (n=24)	I would feel unsure about providing adequate patient care 43.1% (n=53)	I would feel unable to provide patient care 2.4% (n=3)	No answer 15.4% (n=19)
Does your school require the students to purchase a headlight for patient care?	Yes 15.4% (n=19)	No 82.9% (n=102)			No answer 1.6% (n=2)
Do you feel that dental and dental hygiene students should be required to wear a headlight while providing patient care?	Yes 48.8% (n=60)	No 49.6% (n=61)			No answer 1.6% (n=2)
Do you feel that dental and dental hygiene clinical faculty members should be required to wear a headlight while overseeing patient care in the student clinic?	Yes 31.7% (n=39)	No 66.7% (n=82)			No answer 1.6% (n=2)
The use of a headlight during patient care increases the use of proper ergonomics by the practitioner.	Strongly agree 43.9% (n=54)	Agree 35.8% (n=44)	Neutral 17.1% (n=21)	Disagree 1.6% (n=2)	No answer 1.6% (n=2)
The use of a headlight during patient care enhances the accuracy of assessments and procedures.	Strongly agree 56.9% (n=70)	Agree 33.3% (n=41)	Neutral 8.1% (n=10)	Disagree 0.0% (n=0)	No answer 1.6% (n=2)
The use of a headlight during patient care improves the efficiency of providing patient care.	Strongly agree 52.0% (n=64)	Agree 37.4% (n=46)	Neutral 8.1% (n=10)	Disagree 0.8% (n=1)	No answer 1.6% (n=2)

students who were required or not required to purchase coaxial illumination.

Discussion

The origins of musculoskeletal disorders may occur during dental hygiene clinical education[12,13] and efforts are being instituted to reduce the risks for future oral health care professionals. The growing trend in dental hygiene programs is to mandate all students to purchase magnification loupes with the intent to improve overall ergonomics and reduce risks for musculoskeletal disorders.[23,26] However, limited evidence exists with respect to the experiences and attitudes of dental hygiene students regarding the requirement for purchasing and using magnification loupes and coaxial illumination. Results from this study may provide support to the trending changes in educational policies requiring the purchase and use of magnification and/or coaxial illumination by dental hygiene students.

The purpose of this study was to evaluate the experiences and attitudes regarding the requirement of magnification loupes and coaxial illumination among dental hygiene students in Ohio. In regards to magnification loupes, 89.4% of respondents used loupes even though only 56.1% were required to purchase loupes. Regarding coaxial illumination, 84.5% of respondents used coaxial illumination even though only 15.4% were required to purchase coaxial illumination. Students who were required to purchase magnification loupes felt that dental hygiene students and dental hygiene faculty should all be required to purchase loupes. Students who were not required to purchase loupes felt more strongly about the

Table IV. Relationships between magnification loupe requirements, experience, and attitudes

Magnification loupe experience and attitudes	Magnification loupe requirements			
	Does your school require students to purchase magnification loupes for patient care?		X^2	*p*-value
	Yes	No		
Do you currently use magnification loupes while providing patient care?	62.7%	22.2%	18.574	<.001
Do you feel that dental and dental hygiene students should be required to use magnification while providing patient care?	88.4%	64.8%	37.735	<.001
Do you feel that dental and dental hygiene clinical faculty members should be required to use magnification while providing patient care?	78.3%	77.8%	38.256	<.001

Table V. Relationship between magnification loupe beliefs and requirements

Question	All respondents			Are you required to wear magnification loupes when providing patient care?		*p*-value
	n	Median	IQR	Yes	No	
Loupes increase the use of proper ergonomics	122	1.0	1.0-2.0	60.68 n=68	62.54 n=54	>.05
Loupes increase the accuracy of assessments and procedures	123	1.0	1.0-2.0	54.94 n=69	71.02 n=54	<.01
Loupes increase the efficiency of providing care	123	1.0	1.0-2.0	54.23 n=69	71.93 n=54	<.01

Table VI. Relationship between coaxial illumination requirements, experience, and attitudes

Coaxial illumination experience and attitudes	Coaxial illumination requirements			
	Does your school require students to purchase coaxial illumination for patient care?		X^2	p-value
	Yes	No		
Do you currently use coaxial illumination while providing patient care to your own patients?	17.3%	14.9%	1.272	p>.05
Do you feel that dental and dental hygiene students should be required to use coaxial illumination while providing patient care?	26.7%	56.9%	10.809	***<.001***
Do you feel that dental and dental hygiene clinical faculty members should be required to use coaxial illumination while providing patient care?	28.2%	72.5%	6.796	***<.01***

Table VII. Relationship between coaxial illumination requirements and beliefs

Question	All respondents			Does your school require students to purchase coaxial illumination for patient care?		*p*-value
	n	Median	IQR	Yes	No	
Coaxial illumination increases the use of proper ergonomics	121	1.0	1.0-2.0	61.87 n=19	60.84 n=102	>.05
Coaxial illumination increases the accuracy of assessment and procedure	121	1.0	1.0-2.0	57.29 n=19	61.69 n=102	>.05
Coaxial illumination increases the efficiency of providing care	121	1.0	1.0-2.0	60.03 n=19	61.18 n=102	>.05

benefits of using loupes regarding accuracy of assessments and procedures and the efficiency of providing care. Students required to purchase coaxial illumination felt that all dental hygiene students and dental hygiene faculty should be required to purchase coaxial illumination. However, the requirement for coaxial illumination had no effect on the perceived benefits of using coaxial illumination.

Although dental hygiene student respondents agreed with perceived benefits of both magnification loupes and coaxial illumination, they perceived more benefits from using loupes versus coaxial illumination. The main perceived benefits among dental hygiene students for the use of magnification loupes and coaxial illumination when providing care are increased use of proper ergonomics, increased accuracy of assessments and procedures, and increased efficiency of providing care. These findings are consistent with the attitudes of dental hygiene program directors and practicing clinicians regarding the benefits of using magnification loupes.[23,26,27] In this study, if the respondents were unable to use their magnification loupes, the top two detrimental effects cited were compromised ergonomics and compromised patient care. In regards to coaxial illumination, the top two detrimental effects included discomfort when providing patient care and compromised ergonomics. However, a greater number of respondents seemed to feel that there would be no difference in the provision of patient care with with the lack of coaxial illumination than with the lack of magnification.

Differing views exist about the requirement to purchase magnification loupes and coaxial illumination by students who were required to purchase them versus those who were not required. Students who were required to purchase loupes were more in favor of an overall requirement for hygiene students and faculty to purchase magnification loupes. These respondents may view magnification loupes as the standard of care in the delivery of dental hygiene services. However, the students who were not required to purchase their magnification loupes felt more strongly about the benefits of magnification loupes regarding the accuracy of assessments and increased efficiency. This finding seems to imply that students who choose to purchase loupes may value the investment more than those who were required to purchase them with their clinic kit. Students who were required to purchase coaxial illumination also felt that all dental hygiene students and faculty should be required to purchase coaxial illumination. This may be due to the perceived standard of care achieved with the use of coaxial illumination. Future studies should further explore the attitudes and beliefs resulting from the purchasing and utilization requirements of magnification loupes and coaxial illumination.

Limited evidence exists regarding the student and faculty requirement of magnification loupes and coaxial illumination. Previous research has shown that dental educators using magnification loupes were not entirely convinced about student and clinical faculty requirements regarding magnification loupes.[23,28] Practicing dental hygienists who have always used magnification loupes have been shown to support the required use of loupes.[27] However, occasional and nonusers of magnification loupes stated they may have benefited from the use of loupes during their educational programs and favored magnification loupes as an option, not a student requirement.[27] If clinical faculty members do not conform to the same requirements for magnification loupes and coaxial illumination, enforcing student requirements may become problematic. Since cost has been identified as a challenge, financial support from dental hygiene programs may help increase the use of magnification and coaxial illumination among dental hygiene faculty.

There were limitations to this study. With survey research, no causal relationships can be established with this type of

design. The survey relied on the respondents' self-reported data, and their interpretation of the questions. Because the distribution of the survey relied on program directors to forward the survey to their dental hygiene students, the exact representativeness of the sample could not be calculated and the generalizability of the results could not be determined. Future studies should include a national survey of dental hygiene programs and students to determine whether the student requirement of magnification loupes and/or coaxial illumination is a predictor of musculoskeletal disorders.

Conclusion

Student users of magnification loupes believed in the perceived ergonomic benefits of using loupes, however, students who were not required to purchase loupes felt more strongly about the overall benefits of using loupes. Purchasing requirements for coaxial illumination had no effect on the perceived benefits of using coaxial illumination. Student attitudes should be considered when considering student purchasing requirements for magnification loupes and coaxial illumination.

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Research

Examining the Impact of Dental Hygienists' Professional Appearance: Patients' and dental student providers' perspectives

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Abstract

Purpose: Relationships between patients and their health care provider can impact treatment acceptance and patient compliance. The purpose of this study was to explore whether dental hygienists' hairstyle, clinic attire, and accessories affected patients' and dental student providers' perceptions of professionalism and the role gender plays in these perceptions.

Methods: Survey data were collected from adult patients and dental student providers from a dental school in the Midwestern United States. Study participants rated the professional qualities of male and female dental hygienists photographed with professional versus unprofessional/ less-traditional hairstyles, clinic attire, and accessories. Descriptive and inferential statistics were used to analyze the data.

Results: A total of 402 patients (n=402) and 318 first- and second-year dental students (n=318) consented to participate. Both male and female dental hygienists pictured with less-traditional hairstyles were rated as less professional than clinicians with professional hairstyles on a scale from 1="not at all professional" to 7="very professional (5.28 vs. 6.04; $p<.001$). Males with less-traditional hairstyles (mean=4.74; $p<.001$) received the most negative ratings. Dental student providers rated female clinicians with less-traditional hairstyles least positively, while the patients rated male providers with non-traditional hairstyles least positively.

Conclusions: Hairstyle, in both male and female dental hygienists, was viewed as a physical characteristic influencing perceptions of professionalism among patients and dental students. Overall, male clinicians were evaluated more negatively than females. Gender was not shown to affect the study participants' perceptions of professionalism.

Keywords: professionalism, professional appearance, dental hygienists, dental students, patient perceptions

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Introduction

Relationships between patients and their health care providers has been shown to be of importance in accepting treatment and patient compliance.[1] In medicine, research has shown that the patient-provider relationship affects a wide range of cooperative patient behaviors including medication adherence for Type 2 diabetes,[2] medication compliance following coronary bypass surgery,[3] exercise regimens for patients with osteoarthritis,[4] medication protocols for HIV+ patients,[5] and general medication adherence in the elderly.[6] In dentistry, Patel et al. demonstrated that patients' acceptance of a surgical periodontal treatment plan was a function of their relationship with their provider, and Inglehart et al. found that the frequency of wearing a bite splint was related to the quality of the patient-provider relationship.[8]

Considering the significance of patient-provider relationships, it is important to gain an understanding of the influencing factors. One aspect, extensively investigated in medicine, is the degree to which a health care provider's appearance, specifically clinic attire, hairstyle, and accessories, affect patients' responses to provider recommendations. Research as early as 1987 showed patients had certain preferences for physician attire[9] and traditional attire received more positive responses, while casual, non-traditional clothing choices resulted in more negative responses.[10] These views have not changed substantially over the

years as even in the most recent decade, patients have indicated preference for white coats as clinic attire.[11,12] Traditional professional attire has been shown to inspire more confidence in the provider,[13,14] made patients more comfortable,[15] and increased patients' perceptions of a physician as being more empathetic[16] and more professional.[17] While professional clinic attire has been shown to demonstrate a positive effect in terms of professionalism, research has shown that clinic attire had no impact on patients' satisfaction[18] and that surgeons' clothing had no effect on patients' opinions regarding the care they had received.[19]

Nursing literature has also shown that professional clinic attire was preferred by adult patients[20] and nurses, and that nurses wearing solid color scrubs, as compared to prints, were viewed as being more skilled and knowledgeable.[21] It is noteworthy, however, that white uniforms have been shown to make children more anxious[22] and fearful.[23] In dentistry, only six studies were found related to this issue, with three focusing on pediatric patients' preferences for different clinic attire styles.[24-26] Again, support was found for adult patients' preferences for dentists wearing what is considered to be professional clinic attire.[27,28] Additionally, most female dentists preferred lab coats to other types of clinic attire due to infection control concerns.[29]

No research to date explored the effects of clinic attire on patients' perceptions of dental hygienists, nor has any previous study in the dental literature assessed the impact of hairstyles and accessories on patients' perceptions of their providers. In medicine, research has shown that physical attributes such as hairstyles can have a significant impact on patients' perceptions of their physicians,[10] with certain hairstyles (i.e., short hair) being preferred by patients,[30] and special attention being given to well-groomed beards and mustaches.[31] However, when Brosky et al. asked patients at the Minnesota School of Dentistry to rate the appearance of the dental students and faculty members in the dental clinics, hairstyle was shown to have little impact on patients' opinions of their provider possibly due to their findings that the majority of the respondents described all providers as having a professional appearance.[27]

Concerning patients' opinions regarding accessories, research in medical settings has shown that earrings, especially when worn by male providers, were viewed negatively or as unprofessional,[10,32,33] with nose and lip piercings being most negatively evaluated.[33] In another study, patients indicated that the absence of visible tattoos (30%) and the absence of visible piercings (39%) were important factors.[34] However, the location of the practice[35] and the patients' age might be significant mediators for patients' perceptions and evaluations in this context.[36] Research in dentistry has also shown that patients positively evaluated providers who wore a name tag, safety glasses and a mask.[28,37]

Provider and patient gender may also be a mediating factor when considering the effects of what is considered to be a professional appearance, specifically in the aspects of clinic attire, hairstyle and accessories, on patients' perceptions of their health care providers.[38] However, very limited research has focused on the role of gender and professionalism. The purpose of this study was to explore whether a dental hygienists' clinic attire, hairstyle, and accessories affected patients' and dental student providers' perceptions of their professionalism and the role gender plays in these perceptions.

Methods

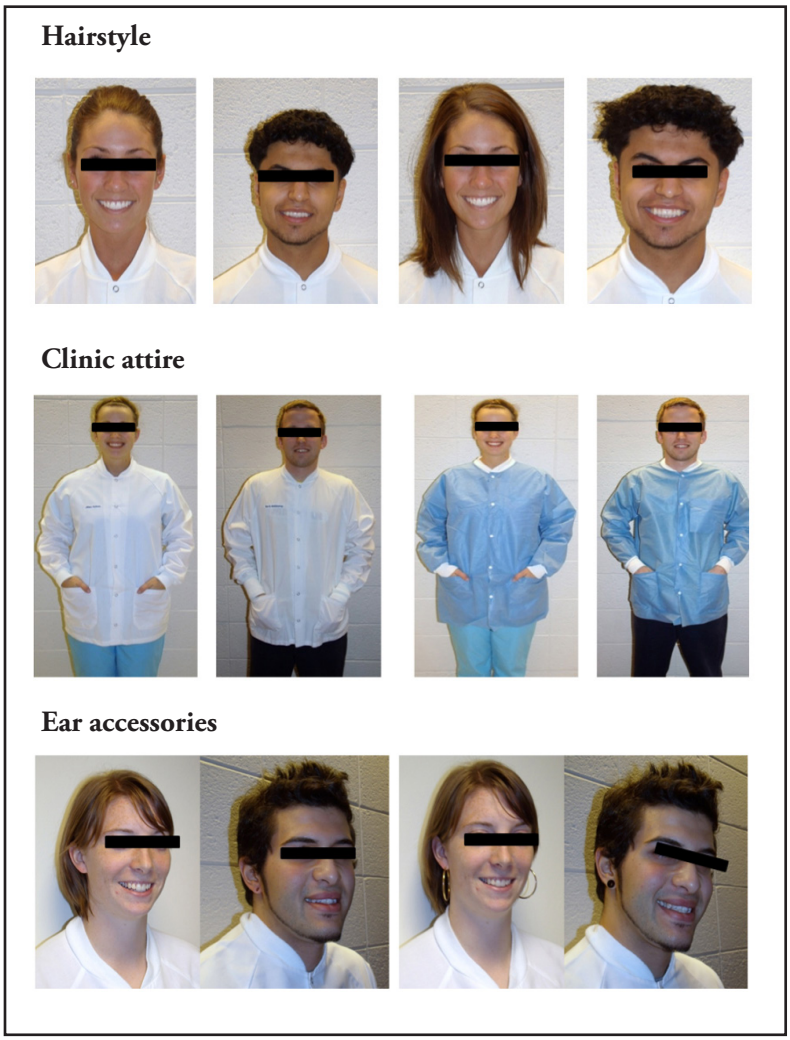
This study utilized a quasi-experimental design, with subjects randomly assigned to view different photographs of hygienists. This research was determined to be exempt from oversight by the Institutional Review Board for the Behavioral and Health Sciences at the University of Michigan, Ann Arbor, MI (HUM#00055794).

An a priori power analysis was conducted to compute the sample size needed to have the power to conduct analyses of variance. It showed a minimum of 269 subjects would be required. Adult patients receiving care at the University of Michigan School of Dentistry were informed about the study and invited to participate in the anonymous survey. Agreeing to respond and complete the survey was considered implied consent. Participants received a free parking voucher upon completion of the survey as a token of appreciation. First and second year dental students comprised the second cohort of participants. Students were informed about the research study at the end of a regularly scheduled class period and invited to respond to an anonymous survey. No instructors were present during the recruitment effort. Students received the surveys and returned them anonymously to the research team.

Each survey consisted of demographic background questions (gender, age, and educational status) and 6 additional sections. Each of the 6 sections contained a photograph of a clinician (dental hygienist) followed by five questions. Three physical characteristics (hairstyle, clinic jackets and ear jewelry/accessory) were selected for evaluation. Traditional hairstyles, clinic jacket and earring characteristics were considered to be "professional" whereas less-traditional characteristics were considered to be "unprofessional" for the purposes of this study. Male and female clinicians were photographed for each characteristic. Participants were asked to evaluate the clinician photographed based on how professional and hygienic the clinician appeared, their level of confidence in the clinician's abilities, their level of trust in the clinician, and whether

they would want to be treated by the clinician. Responses were given on a 7-point answer scale ranging from 1 = "not at all" to 7 = "very much". Participants received three randomly selected sections with male clinician photographs and three sections with female clinician photographs (Figure 1).

Figure 1. Photographs of male and female dental hygienists depicting professional and unprofessional/ less traditional characteristics



The survey was piloted tested by 30 dental hygiene students enrolled in a research methodology class. Changes in the wording of the questions were made based on the feedback received. In addition, a factor analysis (Extraction Method: Principal Component Analysis; Rotation Method: Varimax Rotation) was used to determine if the 5 items loaded on one underlying factor to assess for construct validity. The reliability of the 5-item scales was determined with Cronbach alpha inter-item consistency scores and the reliability was considered to be excellent.

Descriptive statistics, such as percentages and means, were computed to provide an overview of the responses. Independent sample t-tests were used to compare the mean responses to professional versus unprofessional/less traditional photographs. Two- and three-way analyses of variance were used to test whether the average responses in regards to the male versus female clinicians with professional versus unprofessional/less-traditional appearance differed and whether male versus female respondents' mean responses differed in regards to the gender of the clinicians photographed with various physical attributes.

Results

A total of 402 adult patients ranging in age from 18 to 93 years (n=402; mean: 54 years) and 318 first- and second-year dental students ranging in age from 20 to 40 years (n=318; mean: 25 years) consented to participate. Participant demographic information is shown in Table I.

In general, all of the clinicians depicted in the photographs were rated positively for the three areas of consideration: hairstyle, clinic attire, and ear accessories with means ranging from 4.85 to 6.12 on a 7-point answer scale, with "7" indicating the most positive rating.

Male and female clinicians with less traditional hairstyles were on average rated as less professional and less hygienic; respondents were less confident in their abilities, had less trust in them, and had less of a desire to be treated by them. Ratings of professionalism were not affected whether the clinician photographed wore a white, traditional clinic jacket versus a blue jacket. Clinicians photographed wearing unprofessional/less-traditional ear accessories (i.e., ear plugs) were rated on the average rated as less professional than clinicians with professional

Table I. Participant demographics

Characteristic	Patients n = 402	Students n = 318	*p*-value
Gender			
male female	174 (43%) 228 (57%)	178 (56%) 140 (44%)	<.001
Mean age	**53.71**	**25**	
SD Range	17.817 18-93	2.990 21-40	<.001
Year of dental school:			
First Year Second Year	n/a	209 (66%) 109 (34%)	–
# Years of education:			
< 9 years 9-12 years 13-14 years 15-16 years >16 years	4 (1%) 55 (14%) 97 (24%) 78 (19%) 136 (42%)	n/a	

accessories. Responses for all three areas of consideration (means and standard deviations) are shown in Table II.

Table II. Evaluations of clinicians with traditional versus less traditional (all respondents; mean and standard deviation)

Hairstyle	Professional[1]	Unprofessional/ less traditional[1]
How professional is this clinician?	6.04 (1.046)	5.28*** (1.490)
How hygienic is this clinician?	6.12 (1.024)	5.28*** (1.506)
How confident are you in this clinician's abilities?	5.71 (1.162)	5.23*** 1.426)
How much would you trust this clinician?	5.68 (1.216)	5.21*** (1.471)
How much would you want this clinician to treat you?	5.77 (1.209)	5.15*** (1.602
Clinic jacket	**Professional**	**Unprofessional/ less traditional**
How professional is this clinician?	5.88 (1.132)	5.82 (1.158)
How hygienic is this clinician?	5.86 (1.138)	5.84 (1.171)
How confident are you in this clinician's abilities?	5.61 (1.210)	5.54 (1.259)
How much would you trust this clinician?	5.60 (1.223)	5.55 (1.282)
How much would you want this clinician to treat you?	5.60 (1.238)	5.55 (1.314)
Accessories	**Professional**	**Unprofessional/ less traditional**
How professional is this clinician?	5.07 (1.459)	4.92* (1.480)
How hygienic is this clinician?	5.05 (1.433)	5.15 (1.379)
How confident are you in this clinician's abilities?	4.95 (1.424)	4.92 (1.401)
How much would you trust this clinician?	4.95 (1.046)	4.89 (1.490)
How much would you want this clinician to treat you?	4.89 (1.567)	4.85 (1.554)

Responses range: 1 = not at all to 7 = very much (=most positive response)

Significance levels of the main effect "Professional versus not professional/less-traditional" photograph: * = p<=.05; ** = p<=.01; *** = p<=.001

The gender of the clinician photographed was shown to have a significant effect on the respondents' rating levels in all three areas (hairstyle, clinic attire, and ear accessories). In all three areas, male clinicians were rated as less professional than the female clinicians in all five of the related response items (main effect: clinician gender). The interaction effects between the photographed clinician's gender and their professionalism ratings were also significant for each dependent variable for hairstyles and clinic attire. Female providers with a professional hairstyle received the most positive evaluations, while the male provider with the unprofessional/less-traditional hairstyle received the least positive evaluations.

A slightly different pattern of responses was found for the five mean ratings of the male versus female providers and clinic attire. The female provider with the white clinic jacket had the most positive mean evaluations, while the male provider with the white jacket was viewed less positively. No significant interaction effects were found between the clinician gender and the professionalism ratings of ear accessories. An overview of the professionalism ratings of the male versus female clinicians comparing the professional versus unprofessional/less-traditional hairstyles, clinic jackets, and ear accessories is shown in Table III.

Given that the ratings of clinicians with different hairstyles had an inter-item consistency of Cronbach alpha=.947, the ratings of clinicians with different clinic jackets had an alpha of .949, and the ratings of clinicians with different ear accessories had an alpha of .965, three indices were computed as a measure of overall professionalism by averaging the five responses in each of the three appearance categories. Female depicted clinicians were consistently more positively evaluated in each of the three categories as compared to the male depicted clinicians (Figure 2).

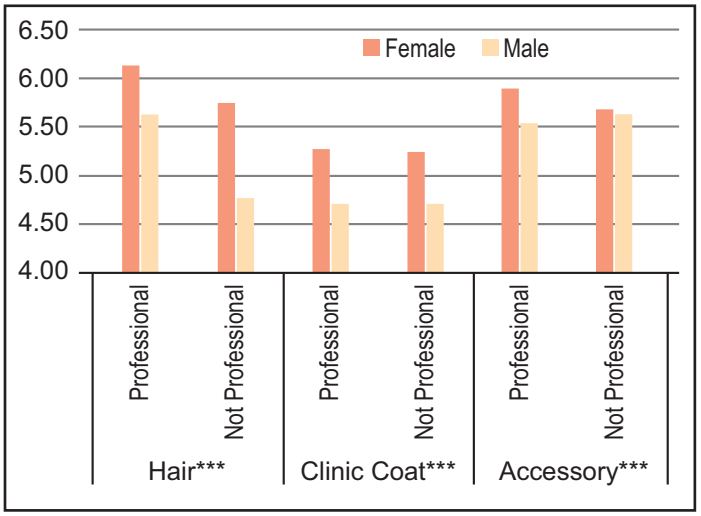
In addition to analyzing the effect of the depicted clinician's gender (Table III) differences in the gender of the respondents' evaluations of the professional versus unprofessional/less-traditional characteristics were also investigated first for female clinicians and followed by a second set of analyses for male clinicians. The interaction effects of "participant gender" and "type of hairstyle" were significantly different for all five questions related to hairstyle in the analysis of female clinicians. Female participants consistently rated female clinicians with professional hairstyles most positively on

Table III. Evaluations of categories by gender of the depicted clinician (all respondents; mean, standard deviation)

	Clinician Gender P (Gender)[1]	Professional photograph	Unprofessional/ less traditional photograph P (Profession)[2]	Interaction effect P (G x P)[3]
Hairstyle				
How professional is this clinician?	Male***	5.764 (1.067)	4.73 (1.549)***	***
	Female	6.31 (0.956)	5.83 (1.200)	
How hygienic is this clinician?	Male***	5.77 (1.076)	4.78 (1.531)***	**
	Female	6.45 (0.851)	5.80 (1.292)	
How confident are you in this clinician's abilities?	Male***	5.52 (1.133)	4.83 (1.465)***	**
	Female	5.90 (1.356)	5.64 (1.161)	
How much would you trust this clinician?	Male***	5.48 (1.184)	4.79 (1.541)***	***
	Female	5.88 (1.218)	5.64 (1.262)	
How much would you want this clinician to treat you?	Male***	5.45 (1.219)	4.58 (1.695)***	***
	Female	6.06 (1.126)	5.73 (1.265)	
Average evaluation (Cronbach alpha=.947)	Male***	5.60 (1.024)	4.74 (1.446)***	***
	Female	6.12 (0.943)	5.73 (1.093)	
Clinic Jacket				
How professional is this clinician?	Male**	5.69 (1.247)	5.85 (1.127)	***
	Female	6.06 (0.980)	5.80 (1.189)	
How hygienic is this clinician?	Male**	5.07 (1.198)	5.82 (1.194)	*
	Female	6.02 (1.054)	5.86 (1.148)	
How confident are you in this clinician's abilities?	Male**	5.44 (1.282)	5.53 (1.270)	*
	Female	5.76 (1.116)	5.55 (1.248)	
How much would you trust this clinician?	Male***	5.42 (1.322)	5.51 (1.318)	*
	Female	5.77 (1.096)	5.59 (1.245)	
How much would you want this clinician to treat you?	Male***	5.41 (1.337)	5.51 (1.344)	*
	Female	5.78 (1.109)	5.58 (1.283)	
Average evaluation (Cronbach alpha=.949)	Male***	5.53 (1.060)	5.64 (1.032)	**
	Female	5.88 (1.048)	5.68 (1.148)	
Ear Accessories				
How professional is this clinician?	Male***	4.73 (1.541)	4.58 (1.547)*	
	Female	5.41 (1.288)	5.25 (1.333)	
How hygienic is this clinician?	Male***	4.79 (1.466)	4.93 (1.459)	
	Female	5.30 (1.356)	5.37 (1.258)	
How confident are you in this clinician's abilities?	Male***	4.73 (1.462)	4.70 (1.504)	
	Female	5.18 (1.347)	5.13 (1.258)	
How much would you trust this clinician?	Male***	4.65 (1.543)	4.61 (1.560)	
	Female	5.24 (1.333)	5.17 (1.290)	
How much would you want this clinician to treat you?	Male***	4.57 (1.625)	4.56 (1.639)	
	Female	5.21 (1.435)	5.14 (1.409)	
Average evaluation (Cronbach alpha=.965)	Male***	4.69 (1.432)	4.68 (1.451)	
	Female	5.27 (1.247)	5.21 (1.216)	

1. Significance levels of the main effect "Clinician's gender" indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
2. Significance levels of the main effect "Type of picture: professional vs. unprofessional/less traditional " indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
3. Significance levels of the interaction effect between "Clinician's gender" and "Type of picture: professional vs. unprofessional/less traditional " indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
4. Response range: 1 = not at all to 7 = very much (=most positive response).

Figure 2: Average overall responses to male versus female clinicians with professional versus unprofessional/ less traditional appearance



Responses range:1 = not at all to 7 = very much (=most positive response).
*** = p<=.001

all five attributes and consistently rated female clinicians with unprofessional/less traditional hairstyles least positively, while male participants' responses fell between the female subjects' responses. Female evaluations of male clinicians with professional hairstyles were also rated most positively compared to the overall evaluations of male participants (Table IV).

The type of clinic jacket and ear accessories worn by female clinicians did not result in significantly different evaluations by male versus female participants, nor did the type of ear accessories worn by male clinicians. However, male and female participants differed in their evaluations of male clinicians and the type of clinic jacket worn (Table IV).

One final question examined was whether patient participants differed from dental student participants in their ratings of the male versus female clinicians in each of the appearance categories (Table V). While there was no significant main effect of the participants' role (dental student versus patient) for the hairstyle and clinic jacket related responses, dental students consistently evaluated the depicted female and male clinicians in the ear accessory category more negatively than the patients. When analyzing whether students versus patients differed in their responses to female versus male depicted clinicians with professional or unprofessional/less traditional hairstyles, the data showed that students consistently evaluated female clinicians with unprofessional hairstyles less positively than the patients. Patients however, consistently rated male depicted clinicians with unprofessional/less traditional hairstyles least positively.

Discussion

Medical and dental[1-8] research explored which role relationships between patients and clinicians can play in patients' treatment acceptance and compliance. Gaining a better understanding of the factors impacting these relationships is critical to improving patient care outcomes. One significant factor in this context is the perceived level of professionalism of health care providers in medicine and dentistry.[10-29] The Commission of Dental Accreditation (CODA) included Standard 2-19 on ethics and professionalism among their CODA standards for dental hygiene education programs.[39] Consequently, dental hygiene students learn the aspects of professionalism during their education,[40] and graduates strive to uphold the dental hygiene oath to maintain the highest standards of professional competence and personal conduct.[41]

Dental hygienists' overall appearance may be viewed as one aspect of personal conduct and has been shown to play a role in patient-provider interactions. Research in medicine has shown that unprofessional hairstyles,[10,30,31] clinic coats[9-17] and accessories[10,32-34] negatively affected patients' evaluations. This study focused on how patients and dental students, considered as future dentists, evaluated these three characteristics portrayed in photographs of both male and female dental hygienists. The descriptions of the two types of appearances described in this study as professional vs. unprofessional/ less traditional, deserve further discussion. The dental school in which this study was conducted has clearly defined appearance guidelines in their best practices' clinic guide. The photographs described in this study as "professional" followed these guidelines while the photographs described as "unprofessional" did not follow the guidelines. However, for the general population or for the patient participants in this study, the distinction between what is considered to be professional and unprofessional appearance may differ greatly. Patients' own values might affect their responses to dental hygienists' attire and physical characteristics. To reflect this possibility, the term "less traditional" was added to the term "unprofessional." In addition, dental students, as future dentists and potential employers, may develop their perceptions of professionalism based on their experiences as students. Including dental students in the study population, added an additional perspective to the data.

Overall, an unprofessional/less traditional hairstyle resulted in significantly fewer positive evaluations than a professional hairstyle. However, wearing a white (professional) vs. blue clinic jacket did not affect the average evaluations in this study. It is possible that more casual outfits such as cartoon

Table IV. Male vs. female respondents' evaluations of male vs. female clinicians with professional vs. unprofessional/less traditional appearance (mean and standard deviation)

Hairstyle	Subject gender[1]	Female clinician: Hairstyle		Male clinician: Hairstyle	
		Professional	Unprofessional/ Less traditional[2]	Professional	Unprofessional/ Less traditional[3]
How professional is this clinician?	Male	6.20 (1.006)	5.92***	5.74 (1.009)	4.72 (1.481)***
	Female	6.42 (0.878)	5.76 (1.239)	5.78 (1.121)	4.75 (1.626)
How hygienic is this clinician?	Male	6.40 (0.861)	5.94 (1.200)***	5.71 (1.107)	4.79 (1.473)***
	Female	6.50 (0.841)	5.67 ((1.360)	5.82 (1.053)	4.76 (1.601)
How confident are you in this clinicians' abilities?	Male*	5.71 (1.218)	5.66 (1.218)**	5.50 (1.156)	4.81 (1.397)***
	Female	6.11 (1.040)	5.62 (1.303)	5.54 (1.120)	4.85 (1.542)
How much would you trust this clinician?	Male	5.72 (1.275)	5.69 (1.240)**	5.43 (1.208)	4.80 (1.455)***
	Female	6.05 (1.118)	5.59 (1.284)	5.53 (1.164)	4.77 (1.633)
How much would you want this clinician to treat you?	Male	5.94 (1.145)	5.82 (1.239)***	5.39 (1.258)	4.56 (1.630)***
	Female	6.19(1.103)	5.65 (1.287)	5.50 (1.192)	4.60 (1.763)
Clinic Jacket	**Subject gender[1]**	**Female clinician: Clinic jacket**		**Male clinician: Clinic jacket**	
		Professional	**Unprofessional/ Less traditional**	**Professional clinic coat**	**Unprofessional/ Less traditional**
How professional is this clinician?	Male	5.99 (0.927)	5.73 (1.199)	5.77 (1.218)	5.79 (1.104)**
	Female	6.13 (1.034)	5.85 ((1.179)	5.63 (1.270)	5.91 (1.156)
How hygienic is this clinician?	Male	5.92 (1.016)	5.81 (1.196)	5.75 (1.191)	5.77 (1.167)*
	Female	6.13 (1.090)	5.90 (1.115)	5.67 (1.203)	5.87 (1.228)
How confident are you in this clinicians' abilities?	Male	5.66(1.087)	5.41 (1.355)	5.42 (1.266)	5.48 (1.212)*
	Female	5.88 (1.139)	5.67 (1.144)	5.46 (1.301)	5.58 (1.339)
How much would you trust this clinician?	Male	5.69 (1.062)	5.46 (1.328)	5.43 (1.328)	5.49 (1.298)*
	Female	5.86 (1.129)	5.70 (1.164)	5.42 (1.324)	5.54 (1.341)
How much would you want this person to treat you?	Male	5.70 (1.061)	5.42 1.324)	5.33 (1.391)	5.49 (1.265)*
	Female	5.87 (1.161)	5.71 (1.194)	5.47 (1.293)	5.53 (1.431)

Ear Accessories	Subject gender[1]	Female clinician: Accessories		Male clinician: Accessories	
		Professional accessories	Unprofessional/ Less traditional[2]	Professional accessories	Unprofessional/ Less traditional[3]
How professional is this clinician?	Male	5.38 (1.143)	5.37 (1.248)	4.58 (1.586)	4.55 (1.473)
	Female	5.44 (1.439)	5.15 (1.398)	4.90 (1.468)	4.61 (1.613)
How hygienic is this clinician?	Male	5.24 (1.278)	5.52 (1.107)	4.71 (1.430)	4.92 (1.384)
	Female	5.36 (1.441)	5.25 (1.365)	4.89 (1.482)	4.94 (1.531)
How confident are you in this clinicians' abilities?	Male	5.09 (1.283)	5.15 (1.212)	4.65 (1.441)	4.67 (1.469)
	Female	5.28 (1.411)	5.11 (1.298)	4.81 (1.448)	4.73 (1.540)
How much would you trust this clinician?	Male	5.21 (1.262)	5.18 (1.277)	4.58 (1.541)	4.57 (1.538)
	Female	5.27 (1.409)	5.15 (1.306)	4.73 (1.520)	4.64 (1.590)
How much would you want this person to treat you?	Male	5.15 (1.331)	5.20 (1.355)	4.48 (1.599)	4.42 (1.657)
	Female	5.27 (1.542)	5.09 (1.457)	4.66 (1.602)	4.68 (1.624)

1. Significance levels of the main effect "Subject gender" are indicated with * = $p<=.05$.
2. Significance levels of the interaction effects between "Subject gender" and "Type of appearance" for female clinicians only are indicated with * = $p<=.05$; ** = $p<=.01$; and *** = $p<=.001$.
3. Significance levels of the interaction effects between "Subject gender" and "Type of appearance" for male clinicians only are indicated with * = $p<=.05$; ** = $p<=.01$; and *** = $p<=.001$.
4. Response range: 1 = not at all to 7 = very much (=most positive response).

Table V. Dental student versus patient responses regarding professional versus unprofessional/less traditional appearance for female and male clinicians (mean and standard deviation)

Hairstyle	Type of subject[1]	Female clinician: Hairstyle		Male clinician: Hairstyle	
		Professional	Unprofessional /less traditional[2]	Professional	Unprofessional / less traditional[3]
How professional is this clinician?	Students	6.42 (0.747)	5.79 (1.114)***	5.80 (1.024)	4.87 (1.642)***
	Patients	6.22 (1.074)	5.87 (1.278)	5.73 (1.102)	4.62 (1.464)
How hygienic is this clinician?	Students	6.54 (0.706)	5.69 (1.331)***	5.81 (1.046)	4.82 (1.556)***
	Patients	6.38 (0.942)	5.89 ((1.258)	5.73 (1.096)	4.74 (1.516)
How confident are you in this clinician's abilities?	Students	5.87 (1.136)	5.58 (1.143)**	5.45 (1.126)	4.92 (1.595)***
	Patients	5.92 (1.167)	5.68 (1.362)	5.59 (1.134)	4.76 (1.342)
How much would you trust this clinician?	Students	5.81 (1.248)	5.58 (1.175)*	5.45 (1.154)	4.73 (1.619) ***
	Patients	5.93 (1.185)	5.69 (1.337)	5.37 (1.193)	4.84 (1.469)
How much would you want this clinician to treat you?	Students	6.05 (1.037)	5.68 (1.217)***	5.43 (1.111)	4.44 (1.779) ***
	Patients	6.07 (1.197)	5.77 (1.311)	5.47 (1.279)	4.70 (1.607)
Clinic Jacket	**Type of subject[1]**	**Female clinician: Clinic jacket**		**Male clinician: Clinic jacket**	
		Professional	**Unprofessional/ less traditional[2]**	**Professional**	**Unprofessional/ less traditional[3]**
How professional is this clinician?	Students	6.04 (0.885)	5.79 (1.157)**	5.91 (1.009)	5.88 (1.043)
	Patients	5.94 (1.044)	5.80 (1.211)	5.49 (1.403)	5.82 (1.194)
How hygienic is this clinician?	Students	6.24 (0.910)	5.82 (1.141)	5.86 (1.005)	5.86 (1.044)
	Patients	5.84 (1.138)	5.81 (1.161	5.56 (1.335)	5.79 (1.304)
How confident are you in this clinician's abilities?	Students	5.97 (1.003)	5.45 (1.147)*	5.48 (1.230)	5.55 (1.138)
	Patients	5.59 (1.179)	5.51 (1.307)	5.40 (1.333)	5.51 (1.373)
How much would you trust this clinician?	Students	5.97 (0.984)	5.65 (1.190)*	5.48 (1.235)	5.53 (1.133)
	Patients	5.55 (1.283)	5.55 (1.283)	5.37 (1.401)	5.49 (1.449)
How much would you want this clinician to treat you?	Students*	5.99 (0.956)	5.64 (1.221)*	5.45 (1.269)	5.51 (1.156)
	Patients	5.60 (1.205)	5.54 (1.333)	5.37 (1.401)	5.51 (1.480)
Ear Accessories	**Type of subject[1]**	**Female clinician: Accessories**		**Male clinician: Accessories**	
		Professional	**Unprofessional/ less traditional[2]**	**Professional**	**Unprofessional/ less traditional[3]**
How professional is this clinician?	Students**	5.31 (1.154)	5.03 (1.277)	4.74 (1.493)	4.90 (1.598)
	Patients	5.48 (1.388)	5.45 (1.358)	4.72 (1.579)	4.37 (1.481)
How hygienic is this clinician?	Student***	5.11 (1.225)	5.15 (1.256)	4.81 (1.430)	5.17 (1.494)
	Patients	5.44 (1.441)	5.58 (1.231)	4.78 (1.481)	4.77 (1.424)
How confident are you in this clinician's abilities?	Students**	5.08 (1.217)	4.94 (1.163)	4.79 (1.387)	4.99 (1.554)
	Patients	5.26 (1.440)	5.30 (1.318)	4.67 (1.494)	4.51 (1.446)
How much would you trust this clinician?	Student***	5.05 (1.224)	4.97 (1.217)	4.70 (1.491)	4.94 (1.626)
	Patients	5.39 (1.398)	5.34 (1.333)	4.60 (1.567)	4.39 (1.486)
How much would you want this clinician to treat you?	Students**	5.02 (1.313)	4.96 (1.357)	4.59 (1.551)	4.91 (1.674)
	Patients	5.36 (1.511)	5.30 (1.441)	4.55 (1.647)	4.33 (1.582)

1. Significance levels of the main effect "Type of subject: Student vs. patient" are indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
2. Significance levels of the interaction effects between "Type of subject" and "Type of appearance" for female clinicians only are indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
3. Significance levels of the interaction effects between "Type of subject"" and "Type of appearance" for male clinicians only are indicated with * = p<=.05; ** = p<=.01; and *** = p<=.001.
4. Responses ranged from 1 = not at all to 7 = very much (=most positive response).

print scrubs or wearing casual clothing such as jeans or exercise gear might result in more negative evaluations. Wearing large hoop earrings or gauges also did not result in overall more negative evaluations. While these two ear accessories did not affect patients' and dental students' evaluations, it is possible that other accessories such as large earrings worn by male providers,[10,32,33] nose and lip piercings,[33,34] and visible tattoos[34] might have a negative effect on the evaluations, and wearing a name tag, safety glasses and a mask might have more positive effects.[28,37] The practice location[35] and the patients' age and ethnicity might also be significant moderators for patients' perceptions and evaluations of professionalism.[36]

One interesting question is whether these overall perceptions prevail when the clinicians' gender is considered. Given that an estimated 98% of dental hygienists in the United States are female[42] and only about 4.2% of current dental hygiene students are male,[43] it could be both patients and dental students/future dentists apply different considerations for the majority of female dental hygienists versus the minority of males in the profession. Findings from this study showed that overall, photographs of male dental hygienists were consistently more negatively evaluated than females. This finding could imply that educational interventions are needed to inform the public about the increasing numbers of male dental hygienists.

Responses of male versus female participants did not differ overall in this study. However, when the interaction between gender and perceptions of professionalism were explored, the data showed that female patients and dental students rated female dental hygienists with unprofessional/ less traditional hairstyles more negatively than male patients and dental students. In addition, dental students seem to apply higher standards overall regarding professionalism than patients.

This study has several limitations. First, a quasi-experimental design with photographs of male and female clinicians was used. In each category evaluated, (hairstyle, clinic attire and ear accessory), the same male and female clinicians portrayed both the professional and the not professional/less traditional appearances. However, it cannot be ruled out that the three males and the three females used in this study were not markedly different. Future studies should consider using photographs from the same male and female clinicians for each type of appearance in all three categories. A second limitation was the absence of photographs of clinicians from non-European backgrounds, limiting the generalizability of the findings. Future research should explore the role of ethnicity/race in the context of professional appearance of providers. A third limitation was that this study was conducted in a mid-sized city in the Midwestern United States. Cultural and social norms in major cities such as New York or Los Angeles or in rural areas differ, and may affect the evaluations of the characteristics studied. Future research should also consider standardizing the photographs in regard to background and photo size. The lack of standardization of the photographs within and across the sets may have resulted in error variance of the responses. Finally, first and second year dental students do not have extensive clinical experiences and may not be ideal respondents when exploring the role of one's professional education and experiences on evaluations of professionalism. Future studies may consider collecting data from practicing dental hygienists and dentists.

Conclusions

Findings from this study showed that hairstyle, in both male and female dental hygienists, was viewed as a physical characteristic that influenced perceptions of professionalism among both patients and dental students. In general, male clinicians were viewed as being less professional than females, regardless of hairstyle, clinic attire or ear accessory. While the gender of the patient or dental student participant was not shown to significantly affect the perceptions of professionalism, both female patients and female students viewed the female clinician with an unprofessional/less traditional hairstyle most negatively. Characteristics of physical appearance may affect patients' and future dental providers' perceptions of professionalism in dental hygienists.

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Research

Selecting a Bachelor of Dental Science Degree in Dental Hygiene: Stories shared from a narrative inquiry

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Abstract

Purpose: Little is known regarding why prospective dental hygiene students select a four-year entry-to-practice baccalaureate degree rather than a diploma granting program in Canada. The purpose of this study was to explore motivating influences for selecting an entry-to-practice baccalaureate degree in dental hygiene from the perspective of former students.

Methods: This study employed a qualitative narrative inquiry consisting of 20 individual semi-structured interviews with 10 former first-year students of the University of British Columbia's Bachelor of Dental Science (dental hygiene) program. Analysis included deductive and inductive coding, member checking, and researcher memos that facilitated the development of emerging themes.

Results: Primary reasons for selecting a Bachelor of Dental Science degree included: expanding career opportunities, access to graduate education, prestige and status of the university, perceived credibility, in addition to family, cultural, and peer influences.

Conclusion: Findings reveal insights for educational institutions to better understand the possible factors attracting prospective students to a dental hygiene baccalaureate degree program. This information may also be useful for clinicians practicing with a diploma or associate degree who are considering additional education towards a baccalaureate degree.

Keywords: dental hygienists, education, dental hygiene curriculum, baccalaureate degree

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Introduction

Dental hygienists in Canada are educated primarily through three-year diploma programs in approximately 33 post-secondary institutions across the country.[1] Canada offers four dental hygiene degree-completion (DC) programs for dental hygienists who are practicing with a diploma. These DC opportunities are found at the University of British Columbia (UBC) (since 1992), the University of Alberta (since 2000), Dalhousie University (since 2008), and the University of Manitoba (since 2010). In addition to their DC pathways, UBC and the University of Alberta offer four-year, entry-to-practice (ETP) bachelor degrees in dental hygiene (since 2007 and 2017 respectively) for students with no prior dental hygiene education. According to the 2017 Canadian Dental Hygienists Association (CDHA) Job Market and Employment Survey, 21% of dental hygienists in Canada are practising with a bachelor's degree as their highest academic credential but only 6% hold a bachelor's degree specifically in dental hygiene.[2]

According to the American Dental Hygienists' Association (ADHA), there are 57 dental hygiene DC programs and 70 ETP bachelor degree programs in the United States.[3] There has been a growing movement towards creating additional pathways aimed at advancing dental hygiene education over the past decade. The impetus for this movement stems primarily from a sense of responsibility to address the growing health complexities of the public through non-traditional and diverse practice settings, a demand for qualified dental hygiene educators, a need for dental hygiene research, and a desire to advance the profession by aligning with the educational models of other health professions.[4,5]

There is a high level of clinical skill development in dental hygiene diploma education; however, progress towards advanced theory is limited due to the length of diploma-level programs.[4,5] This model of education, focusing on the development of clinical skills, provides limited opportunity to

prepare dental hygienists for roles outside of private practice.[4,5] The CDHA states that furthering one's education in dental hygiene depends on an individual's goals, aptitudes, and interests.[6] Education beyond the diploma or associate degree level would be a natural next step for dental hygienists with a desire to enhance their professional expertise and academic qualifications, increase their knowledge and abilities, develop critical thinking and research skills, take a leadership role in the community, and explore varied career opportunities in non-traditional settings.[6-8] The baccalaureate degree for entry into practice has been proposed in CDHA's 2009 Education Agenda[4] as well as in a 2015 ADHA white paper on transforming the dental hygiene profession for the twenty-first century.[9]

Despite what is known about the outcomes of dental hygiene degree education, there is a limited body of research exploring the motivation for pursuing dental hygiene baccalaureate education from the student perspective. The few existing studies have focused on dental hygiene DC education and examined reasons why practicing dental hygienists holding diplomas or associate degrees returned to university to complete a bachelor's degree.[10-12]

Imai and Craig's mixed-methods survey on 27 dental hygienists who had graduated from UBC's dental hygiene DC program identified the following motivating reasons that diploma dental hygienists have for pursuing a degree: personal satisfaction (93%), increasing knowledge (85%), advancing career (56%), the status afforded by the degree (37%), and for graduate school entrance requirements (8%).[10] Similarly, an older survey by Waring conducted on 189 dental hygienists in the United States also found that personal satisfaction (98%), increasing knowledge and skill (95%), career advancement (81%), and status of a degree (76%) were primary motivators for dental hygienists to complete their baccalaureate degree.[11] A qualitative phenomenological study by Kanji et al. explored reasons why dental hygienists who first earned a diploma returned to university to earn their dental hygiene degree in Canada.[12] Motivating influences shared by these participants included expanding career opportunities in dental hygiene, personal development and a desire for knowledge, remaining competitive, status and recognition, access to graduate education, and third-person influences involving instructors from dental hygiene diploma programs, family, and friends.[12]

Several North American studies that have investigated career outcomes of earning a dental hygiene degree clearly demonstrate that baccalaureate prepared dental hygienists have been more successful in securing employment outside of the clinical practice setting.[13-15] From this research, such employment was found to include positions in education, public health, administration, research, and industry. Position papers and trends suggest that to work in more non-traditional practice settings and with patients exhibiting more complex chronic illness with comorbidities, dental hygienists should have a minimum of a baccalaureate degree to be prepared for expanded interprofessional roles and to deliver the comprehensive care needed for these diverse populations.[4,16]

There appears to be an absence of research which has investigated reasons for pursuing a four-year entry-to-practice dental hygiene degree. This gap in the literature informed a broad student retention study that explored former first-year students' experiences transitioning into a large university and throughout their first year of study at the UBC Bachelor of Dental Science (BDSc) program. Braxton and Hirschy's model of student departure informed this broader study's examination into factors influencing student persistence in higher education.17 Exploring student motivations for pursuing advanced dental hygiene education such as the BDSc degree is relevant as the student retention literature has associated students' educational motivations and career aspirations with their levels of engagement and persistence.[17-20]

Accessibility to the UBC BDSc program is comparable to the other dental hygiene diploma programs in British Columbia in regards to geographical location, the number of students admitted, and eligibility criteria for admissions (pre-requisite subjects and minimum grade point average); however, the financial commitment in the UBC program is higher due to its longer duration. Learning about what motivates students to select baccalaureate education, particularly when such a model is not required for licensure in dental hygiene in North America, can provide meaningful insights for educators, administrators, and professional stakeholders. The aim of this study was thus to explore reasons why students, with no prior dental hygiene education, selected a four-year Bachelor of Dental Science in Dental Hygiene (BDSc) degree at the University of British Columbia rather than a dental hygiene diploma program for entry into practice.

Methods

This qualitative narrative inquiry study examined former first year students' reasons for selecting a BDSc degree. This inquiry was part of a broader study on student retention that exploried students' experiences transitioning into a large university and throughout their first year of study in a BDSc program. Ethics approval was granted by UBC's Behavioural Research Ethics Board.

Since the researchers were interested in learning about the experiences of first year students in the BDSc program

who did not progress to the second year of study, a purposeful sample of former first year students, who had been academically dismissed by UBC, was selected. A total of 30 BDSc students have been dismissed by the institution during their first year of study due to academic challenges since the program's inception in 2007 up to 2015. All 30 former students received an electronic letter of invitation sent by a third-party recruiter to participate; a follow-up invitation was sent two weeks later. Of the 30 prospective participants who met the inclusion criteria,10 former students volunteered to participate.

Clandinin defines narrative inquiry as the study of human lives to honor lived experiences that are storied into a narrative chronology.[21] Twenty individual interviews were conducted on this sample of 10 former first year BDSc students. Participation was incentivized through an offering of a $50 gift card for each interview. Individual interviews were conducted at two separate times, approximately one week apart, with each former student. Both interviews were conducted by the same interviewer. Two interviews per participant facilitated the study of experience and the emergence of chronological and relational stories that are central to a narrative inquiry.[21,22]

Interviews were conducted in-person or through the telephone and ranged from 44 to 84 minutes each in length. The interview guide was semi-structured, and the questions were open-ended to ensure that space was provided to hear the voices of the participants and to facilitate storytelling.[22] The interview questions were provided to the participants several days before the interview in order to reduce anxiety and to allow for some reflection time to provide more thoughtful responses.

With consent, interviews were audio-recorded and transcribed verbatim to facilitate the thematic coding of emergent themes. Narrative analysis involved an examination of former students' experiences related to temporality, place, and sociality.[21] Participants' experiences were contextualized to time, physical environment, and their social interactions in their first year of study, and were accomplished through descriptive and in-vivo coding[23] (deductive and inductive), member checking, and researcher memos. A codebook was developed outlining a protocol for which codes should be placed in the various thematic categories in order to ensure a consistent and rigorous approach.[24] Transcribed interviews and subsequent interpretative summaries were given to the participants for review and to offer the opportunity to provide corrections and additional information. This process of soliciting participant feedback, termed member checking, serves as an important tool for minimizing the possibility of misinterpreting the meaning of what participants have said.[22] Member checking and researcher memos also helped bracket researcher preconceptions, assumptions, and biases.[22]

Table I. Participant demographics (n=10).

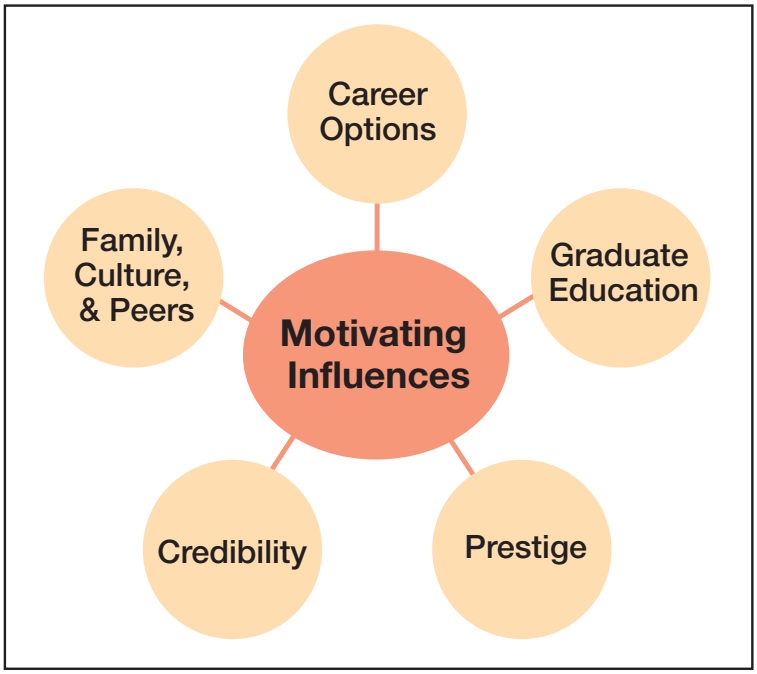
Participant Demographics	Number of Participants
Year Enrolled in BDSc Program	
2007-2008	1
2009-2010	1
2010-2011	1
2011-2012	3
2012-2013	3
2013-2014	1
Age when Enrolled	
17-18	5
19-20	3
21-22	2
Prior Education	
High School Diploma	9
1 year at College	1
Parents' Highest Education Level	
High School Diploma	3
Post-Secondary Diploma or Degree	7
Accommodation	
Commuter: Living off-Campus with Family	9
Residential: Living on Campus	1
Employment Status During First-Year	
Employed Part-Time	4
Not Employed	6
Financial Aid Required	
Yes	6
No	4
Self-Identified Culture	
Chinese	2
Filipino	1
South Asian	3
Vietnamese	1
Western European	2
Mixed (Asian/European)	1

Results

The participants varied in the cohort year in which they were enrolled as a first-year student at UBC, age at enrollment, prior education, parents' highest level of education, accommodation, employment status, financial aid required, and self-identified culture (Table I). Pseudonyms were created to protect participants' identities in their stories shared.

Five prevalent themes emerged from the narrative accounts regarding reasons for selecting the BDSc program at UBC: expanding career opportunities, access to graduate education, prestige and status of the university, perceived credibility, and family, cultural, and peer influences (Figure 1).

Figure 1. Emerging themes regarding motivating influences for selecting a baccalaureate degree dental hygiene program.



Career Opportunities

All participants expressed that they believed earning a BDSc degree would increase career opportunities outside of the traditional clinical practice setting. At the time of application to the BDSc program, participants seemed to have a strong conviction through their own readings and discussions with practicing dental hygienists that a bachelor's degree would be required to explore career paths outside of the private dental practice. Participants were fully informed that a dental hygiene diploma remained the credential for practicing dental hygiene in Canada but desired to invest additional time, energy, and finances into earning an advanced degree due to their career aspirations.

Although research, public health, and independent practice were mentioned as career options of interest, the strongest interest pertained to teaching. For example, Lindsay commented: "I wanted the degree in dental hygiene because it would lead to more career opportunities for me than a diploma." Similarly, Ashley stated: "I found that with the degree program, you could move higher…. if I wanted to be a teacher, if I wanted to do something that's government related..." Likewise, Kristine expressed: "I wanted to pursue a degree because… I want to work in other areas other than a private practice…. like research and teaching. When I did some research, I learned that for other areas of dental hygiene… you need a degree so I think for myself having that opportunity and option to go higher was the reason I wanted to pursue a degree over a diploma."

Access to Graduate Education

Strongly connected with career aspirations, a second theme to emerge was access to graduate education. Several participants had a strong interest in pursuing a graduate degree in the short-term future, and most participants wanted that option to be at least available to them. Participants shared the following desires: "A degree would lead to an easier transition to a masters or a PhD… I wanted to keep that door open" (Ashley), "I could pursue higher education if I wanted to in the future" (James), and "I knew that getting a bachelor's degree was a prerequisite for getting a graduate degree later on" (Jessica).

Prestige and Status

The prestige of attending UBC and earning a university degree was another prominent theme that the former students explicitly highlighted. Participants often used the following words to describe UBC: "top university," "well known," "reputable," "recognizable," and "highly ranked." The prestige attached to earning a degree from a top-ranked well-known university was noted by all: "UBC is one of the top universities in Canada… and in the world… I wanted to be part of that community" (Natasha). "It is a well-known university, who wouldn't want to go there… being part of the name of UBC" (Shora). "Everyone wants to apply to UBC; everyone dreams about getting accepted… it's such a prestigious school" (Kristine).

Several participants also shared their belief that finding employment in any practice setting and networking among professionals would be easier for a graduate from a well-known university due to the institution's reputation. For example, Shora expressed: "… going to a known university… considering future prospects when you try to get a job, they [potential employers] would obviously see that 'oh, she's from UBC' and there's value in that." Others similarly stated: "... the recruitment rate [from future employers] for people who have UBC on their resume is probably a lot higher than other schools" (Ashley) and "UBC also has a good reputation around the world so it would be easier to find a job" (Lindsay). The former students felt purpose in working hard investing additional years to earn a dental hygiene degree from a well-known prestigious university in order to realize the personal validation, societal acceptance, and career opportunities that they were seeking.

Perceived Credibility

A sense of pride and perceived credibility attached with earning a dental hygiene degree compared with a dental hygiene diploma also resonated among all 10 former students. The undertone that members of society and the profession view those with a higher credential in high esteem was prevalent. The former students were proud that they attended UBC and were motivated by the societal recognition and credibility that they perceived the status of a degree to offer ubiquitously. They felt society bestowed those who have earned a degree with additional merit. When describing why they selected the BDSc degree, many participants pointed to the perceived lack of credibility and recognition awarded to a dental hygiene diploma. Participants used words such as "settle," "only," and "just" to describe their feelings about earning a diploma. For example, Yoon stated: "Others will respect you more with a degree" and Aya expressed: "I felt like a degree defines a successful person I believe in education." Jessica shared a similar sentiment: "If I'm capable of getting a degree, why would I settle for a diploma?" Kristine, whose parents had emigrated from Vietnam in order to provide their daughter with a better life, also shared: "When you're applying for a job, a degree counts more than a diploma… it [a degree] is given a higher preference in my opinion… compared with someone who says "oh I have a diploma," people assume that you don't have as much knowledge… "

Family, Cultural, and Peer Influences

The extent to which participants' decisions to apply to UBC and pursue a BDSc degree was influenced by family and peers was considerable and reverberated throughout the narratives. Childhood stories about the importance of education featured prominently. All 10 participants recalled vivid childhood memories about the importance of valuing education to the extent where visualizing themselves as university graduates became part of their social norm in their households and part of their pre-written stories for their future selves. Three participants whose parents did not have post-secondary education recalled strong, consistent messages to strive higher, particularly for those families who immigrated to Canada who made significant sacrifices and desired a better future for their children. For example, Kristine shared the following story: "Both of my parents are Vietnamese immigrants…born in Vietnam into affluent families… once the Vietnam War broke out, both families lost everything… in Vietnam, my mother was able to teach elementary school kids… they immigrated to Vancouver… my Mom ended up working as a bottle sorter at a recycling company."

The financial hardship that some parents experienced served as a strong impetus to pursue higher education to foster a different more lucrative lifestyle. Parents had reaffirmed throughout the primary and secondary school years that attending a well-known university would lead to more rewarding career opportunities. Yoon expressed: "From their [parents] eyes, graduates from UBC were retaining more career options than any other schools." The influence of parents was also prevalent in a comment from Aya: "With pursuing this degree, I would be able to keep my parents happy too." Career aspirations for Kristine also involved influences from her culture: "Growing up in an Asian household, they [parents] have pretty high standards for their kids. Coming from a family where my parents emigrated from Asia, they [parents] worked really hard to build a future for their kids that they might not have had."

Similarly, Yoon, who identified as a Chinese-born Canadian, attributed pressure felt from her parents to attend a reputable university to her Asian culture: "My parents considered UBC to be the Harvard of British Columbia… I did not have much of a choice… there was always this huge pressure on me to do well."

In thinking back to secondary school, participants recalled that many of their best friends from the same geographical area were applying to university and many were headed to UBC. There was a strong desire to maintain these friendships as well as some pressure to keep pace with expectations established in early childhood.

Other Motivating Influences

Other less prevalent reasons for applying to UBC's BDSc program that surfaced from some participants' stories included a desire for more knowledge and self-validation. Three participants were attracted to the four-year dental hygiene degree program because they desired the additional knowledge they expected to acquire in a program of longer duration. Finally, part of the motivating reasons for applying to UBC for Kristine and Jessica included a search for self-validation. Both expressed that they wanted to prove to themselves and to their families that they were capable of exceling in what was perceived to be a challenging top university. Kristine stated: "I wanted to prove that I can achieve higher learning and prove that I can get into one of the top 20 schools in the world." Similarly, Jessica said: "I wanted to show that I was capable of achieving anything."

Discussion

This study makes a novel contribution to the literature as it explores motivators for selecting a four-year ETP dental hygiene baccalaureate degree program intended for applicants with no prior dental hygiene education. Results from this

study stem from a broader study on student retention focusing on their experiences throughout their first year of study in a dental hygiene baccalaureate program at a large university. The rationale for selecting former first-year students who did not progress in their dental hygiene studies due to academic dismissal was to provide program administrators with unique insights into the challenges experienced by BDSc students that can inform institutional policies and practices to better support entering students. The motivating reasons for selecting a dental hygiene degree from this population of former first-year students who were institutionally dismissed aligns closely with existing literature about motivators on students who have been successful in their dental hygiene degree-completion (DC) studies.17-20 Findings from the larger study of first-year BDSc student experiences will be discussed in a future paper.

All 10 participants in this study expressed a desire to earn a dental hygiene bachelor's degree to broaden their prospective career opportunities. Pursuing higher levels of dental hygiene education to expand career options outside of clinical practice has been a dominant theme across past research in which study participants have expressed interest in seeking employment in such areas as education, public/community health, residential care, administration, industry, and research.[8,10-12] Several studies have investigated practice outcomes of earning a dental hygiene degree and have clearly demonstrated that dental hygienists with a baccalaureate degree are more likely to practice in educational institutions, government health authorities, professional associations, regulatory bodies, industry, and graduate degree studies.[13-15] Most recently, Kanji and Laronde's 2018 study on career outcomes of dental hygiene baccalaureate education demonstrated that 45% of the respondents were employed in non-clinical practice settings.[15] In addition, 35% of the respondents indicated that the bachelor's degree was required for employment, and 86% stated their degree was considered an asset.[15]

Participants in this study also expressed an interest in pursuing graduate studies and recognized that a bachelor's degree would serve as a bridge for master's and doctoral programs. Access to graduate education has been previously documented as a motivating influence in prior related research in which participants expressed interest in pursuing a master's degree to further broaden and deepen their knowledge base and open additional career opportunities.[8,10,12] Kanji and Laronde found that over 25% of UBC BDSc graduates have pursued graduate education in the areas of adult education, business administration, dental and craniofacial sciences, and public health.[15] Adopted from earlier student retention theorists, Braxton and Hirschy included several student entry characteristics to help predict student persistence in higher education and incorporated motivational attributes of individuals which can shape students' levels of commitment.[17] They posited that students' commitment to a particular program or institution is influenced by their career and academic aspirations. A student who expects to pursue doctoral studies, for example, is more likely to complete an undergraduate degree.[17]

The prestige of attending UBC and the perceived social status and credibility awarded to earning a degree, particularly when compared to a dental hygiene diploma, emerged as a motivating influence for pursuing a BDSc degree. This finding has also been documented in Imai and Craig's study in which 37% of survey respondents cited the status of the degree as a *very important* motivator.[10] Dental hygienists in Kanji et al.'s phenomenological study had also expressed frustration at the lack of recognition that other health professionals and the public bestow towards a dental hygiene diploma.[12]

Mirowsky and Ross state that education forms a unique and powerful dimension of social status.[25] They assert that educational attainment marks social status at the beginning of adulthood, preceding and therefore influencing other acquired social statuses such as occupational status, personal and household income, and freedom from economic hardship. Education helps develop *human capital* which Mirowsky and Ross defined as the productive capacity developed and embodied within human beings.[25] Similarly, Bourdieu's theory of social reproduction posits that societal structure determines an individual's place in society, asserting that education can be a successful mechanism to reproduce social inequalities.[26] The structure and distribution of the different forms of capital can represent the structures of the social world and may manifest as educational achievements which can influence social status.[26]

Approaching status from a profession's lens, Clovis' foundational article discussing attribute theories and the professionalization of dental hygiene declares that the amount of education required and the extent of specialization are central to achieving professional status.[27] Establishing baccalaureate dental hygiene programs in universities will further contribute to society's understanding that the degree of specialization in dental hygiene is high and will garner further recognition that dental hygiene remains the only health profession dedicated to the prevention of oral disease.[4,27] Whether considering an individual's perceived credibility in society, the impact of education on human capital, or the professional status of an occupation, the level of educational attainment and its impact on status appears to be a powerful motivator for pursuing advanced education.

Family and peer influences emerged as significant motivators for selecting the BDSc degree at UBC. Messages stemming from participants' parents since childhood about the importance of education and the opportunities that advanced education would enable reverberated throughout the former students' narratives. Within the context of dental hygiene, the only other study that documented family and peer influence as a motivator for pursuing post-diploma DC education was Kanji et al. who noted that encouragement from instructors from dental hygiene diploma programs, parents, and close friends profoundly influenced decisions to apply for DC education.[12] Whereas in some cases, participants in their study were motivated to earn a bachelor's degree because everyone else in their family had earned degrees, other participants desired to be the first in their family to achieve this educational milestone.[12]

Buddel's narrative inquiry on first-generation university student persistence also discussed how parents and grandparents storied the value of higher education and future roles as university students in the lives of their children, integrating a family narrative towards pursuing a university degree.[28] Students were deeply affected by their families' financial struggle to survive which served as a powerful impetus to break free, be different, and want more through pursuing higher education.[28]

Pressure from parents to attend and excel in university felt particularly strong for three participants in this study who identified as Chinese or Vietnamese. They expressed that being raised in an Asian household, attending university was extremely important since their parents sacrificed so much in immigrating to Canada for a better life for their children. This message of sacrifice and the value of education permeated throughout their household habitus. These narratives closely correlate with other studies exploring Asian students' experiences in higher education which demonstrate that Asian students are feeling excessive pressure from parents and peers to excel academically.[29-31] Research that has explored the Model Minority Stereotype (MMS), which labels Asian Americans as the model of success, speaks to the extent to which Asian Americans themselves may have internalized the MMS and its potential harm to their mental health demonstrating that the MMS and associated pressures to excel academically have been significant sources of chronic stress for students.[29-32]

Other less prevalent reasons for applying to the BDSc program included a desire for more knowledge. The desire for more knowledge acquired in a degree program of longer duration compared to a dental hygiene diploma is consistent with the findings in Imai and Craig's survey in which 85% of survey respondents noted *to increase knowledge* as a *very important* reason for pursuing a BDSc degree.[10] Kanji et al. also reported that dental hygienists practising with a diploma returned to university to complete their bachelor's degree to deepen and broaden their knowledge within and outside of dental hygiene theory.[8,12]

In 2015, the CDHA published the *Canadian Competencies for Baccalaureate Dental Hygiene Programs* outlining the additional educational competencies that dental hygiene students are expected to demonstrate in a baccalaureate dental hygiene program as compared to a diploma program. These additional competencies include: research use, policy use, disease prevention (population level), and leadership.[33] Studies that have investigated ability-based outcomes of earning a dental hygiene baccalaureate degree have reported that dental hygienists feel they have acquired additional knowledge and feel more competent in reading and appraising research, using research to inform practice decisions, academic writing and communication skills, and interprofessional collaboration as a result of their DC education.[7,8] Existing research on motivators and outcomes of dental hygiene baccalaureate education should serve as impetus for further dialogue within educational institutions, professional associations, regulatory bodies, and government about offering additional opportunities for dental hygienists to advance their education.

Self-selection bias may have been a limitation in this study. Students with the greatest perceived resentment towards the program or university may have opted not to participate due to negative feelings of anger and embarrassment. This study also reports results from a single institution. Future research can integrate student motivators for selecting baccalaureate education across Canadian and American dental hygiene baccalaureate programs to collect more national data on rationale for selecting dental hygiene education programs beyond the entry-to-practice requirements. Investigating motivators for pursuing graduate level dental hygiene education and associated practice outcomes also warrant investigation. Conversely, barriers to pursuing advanced education in dental hygiene appear not to have been explored.

Conclusion

This study makes a novel contribution to the dental hygiene literature by exploring motivating influences for selecting a four-year entry-to-practice BDSc degree at a Canadian university from the perspective of former first-year BDSc students. Results from this qualitative narrative inquiry strengthen the understanding of reasons for advancing one's dental hygiene education: career opportunities outside of

the clinical practice setting, access to graduate education, prestige/status of earning a degree, perceived credibility, and family, peer, and cultural influences. These findings provide insight for dental hygiene educational administrators to better understand what may motivate prospective students to their baccalaureate programs. This information may also prove useful for those dental hygienists practicing with a dental hygiene diploma or associate degree who are considering additional education.

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