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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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Leadership Opportunities for Collaborative Change in Health Care

Jennifer L. Brame, RDH, MS



The World Health Organization (WHO) has conveyed the importance of interprofessional education (IPE) to achieve teamwork among health care professionals, highlighting the need for collaborative practices to strengthen health care systems and improve health outcomes.¹ As our population ages and health complexities increase, an emphasis has been placed on person-centered integrated care models to improve timeliness and quality of care, support interprofessional relationships, and serve to mitigate the global health workforce crisis.¹ The Institute of Medicine (IOM) states that, “health professionals should be educated to deliver patient-centered care as members of an interdisciplinary team...” noting that patient care may be delivered with higher quality when provided in effective health care teams that communicate well and understand one another’s roles.²

Interprofessional education (IPE) strives to create synergistic opportunities for students from two or more health professions to learn about, from and with each other.¹ Collaborative practice (CP) is characterized as having multidisciplinary health care teams trained in interprofessional education to optimize skills to deliver the highest quality of care.³ Both share a common goal of maximizing professional strengths in concert to provide optimal patient care.

Professional silos in education create nonfunctional relationships based on power, hierarchy, and competition.⁴⁻⁵ Students who have learned in these fragmented systems are expected to provide team-based care later on in practice, yet they are not equipped with the essential skills. IPE promotes sharing of knowledge, effective communication, breakdown of professional stereotyping, and ultimately the development of high-quality care.⁶⁻⁷

There is a sense of urgency to incorporate IPE and CP models as the population needs are evolving at a faster rate than our ability to adapt. Leaders in education are partnering

to create commonality in accreditation standards to connect program competencies and training approaches. The Health Professions Accreditors Collaborative (HPAC) was created to achieve collaboration and calibration between various accreditors; the Commission on Dental Accreditation is a member of this organization. The HPAC and the National Center for Interprofessional Practice and Education recently published guidelines for the development of quality interprofessional education programs in health care.⁸ Development of these guidelines further reiterates the need of health professions programs to partner and create consistent learning IPE experiences to prepare the future workforce for integrated team care.

In order for meaningful creation and implementation of IPE to occur, the academic culture must shift. Dental hygiene educators must develop partnerships to create opportunities for intra- and inter-professional integration and collaboration. This is not only critical for promotion of the profession and sustaining our role in the evolving health care system, it is key in advocating for our patients who currently navigate a fractured and inefficient health care system.

Dental hygiene education has historically been a late adopter of these IPE standards and interdisciplinary collaborations, leaving the profession comfortably siloed but ultimately threatened as change happens around and to us. We must adapt, lead, change, and strive to enhance our delivery of care. It is our responsibility to empower the profession and lead initiatives that will prepare future oral health care providers to be nimble and practice-ready. Dental hygiene educators are central to these changes and must leverage partnerships with other health disciplines and lead collaborative teaching initiatives to create meaningful impact for our students, patients, and profession. IPE can serve as a high-impact teaching opportunity fostering critical thinking and active

learning, while promoting a holistic person-centered approach bending the learner's lens beyond the mouth.

While IPE emphasizes learner experiences, it is also critical for the current workforce to gain interprofessional knowledge to develop integrated health care delivery systems. The drive for increased IPE and CP initiatives will continue as global health care models utilize task shifting; integrating dentistry and medicine; thus, impacting the future of our profession by providing opportunities to expand our relevance and contribute to enhanced patient experiences. However, we must first be cognizant of these changes and engage in conversations to ensure we are not missing this opportunity to integrate, collaborate, and grow. In his editorial, "Dentistry at a Crossroads," Dr. Michael Glick addresses the necessity to embrace change while preserving our professional autonomy through the demonstration of evidenced-based practices that promote our role as oral health care experts.⁹ Glick states, "Unless we embrace the tools to critically appraise the readily available scientific evidence that inform our practices, we will fall behind and may no longer be invited to sit at the table where the future of health care is being discussed."⁹ This is a critical time for the dental hygiene profession to define our role and highlight our relevance in the future health care workforce model, with IPE and CP at the centerpiece of these transformations.

As dental hygienists, we must advocate for our profession. Opportunities and challenges come with change, but as a profession, we can thrive in this new model by cultivating partnerships to make meaningful contributions to the development of interprofessional team-based care. Dental hygiene leaders must partner to advocate for collaborative practice both within the profession and to other health professionals as we promote our professional value and advocate for improved health care outcomes. We need to solicit engagement and commitment from stakeholders and create relationships through networking to collaborate on the development of intentional, sustainable, and meaningful interprofessional strategies. The dental hygiene profession must demonstrate the courage to lead changes that will define our role and shape our impact in the future health care system.

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Collaborative Educational Experiences of Dental Hygiene and Audiology Students

Jennifer L. Brame, RDH, MS; Emma Gibbings, BS; Vicki Kowlowitz, PhD;
Nancy M. McKenna, PhD. AuD; Jane A. Weintraub, DDS, PhD

Abstract

Purpose: An innovative, collaborative interprofessional experience for dental hygiene and audiology students that included hearing assessments and a class lecture/discussion session was developed and implemented at the University of North Carolina, Chapel Hill. The purpose of this study was to evaluate whether the objectives were met for the initial educational experience and to identify areas for improvement.

Methods: Audiology students, under faculty supervision, provided hearing screenings for 33 senior dental hygiene (DH) students and 4 graduate (DHE) students. In a subsequent didactic session for the DH and DHE students, an audiology doctoral student presented on the following topics: overview of the audiology profession, interprofessional collaboration with audiologists, principles of noise-induced hearing loss, protective measures for hearing health, and techniques for communicating with patients with hearing loss. Class discussion followed the lecture presentation. Surveys on the screening and education session were completed by the students and changes in their perception of knowledge were assessed.

Results: Nearly half (49%) of the students indicated that this was their first hearing assessment. The vast majority (97-100%) agreed or strongly agreed that the experience was well-organized, contained important information for dental practice, and increased their understanding of the importance of collaboration and their comfort level in working with audiologists. Nearly all of the students (94%) recommended this experience be included in future curriculum. Significant changes were reported in students' knowledge of hearing assessments, noise induced hearing loss, and communication with patients with hearing loss (Wilcoxon Signed Rank Test, $p < 0.05$).

Conclusion: The educational objectives of this initial interprofessional collaborative experience were met. Participants reported that the didactic and experiential education was a valuable learning experience and it increased their knowledge about the audiology profession and hearing health for themselves and their patients.

Keywords: dental hygiene education, audiology, hearing assessments, interprofessional education, interprofessional collaboration

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Introduction

Ineffective or inadequate communication between patients and health care providers may result in a plethora of complications including misdiagnosis, lack of understanding of treatment needs, failure to receive accurate informed consent for care, and miscomprehension of treatment recommendations. Incomplete communication can have a cumulative and damaging effect on the information passed between patient and provider. While treatment of patients with

special needs has been broadly included in the Commission on Dental Education Accreditation (CODA) standards for dental hygiene education, the standards do not include specific details regarding patients with hearing impairments who may also have communication challenges.¹ This lack of specificity regarding individuals with hearing impairments can lead to inconsistent and perhaps limited experiences for students, both didactically and clinically.

Hearing loss and auditory symptoms, such as tinnitus (a ringing or noise in the ear), affects people of all ages. Approximately 2-3 out of every 1,000 children are born in the United States (U.S.) with a detectable degree of hearing loss.² The prevalence increases with age, with about 1% of the U.S. population between the ages of 20-39 years affected, 3% between 40-49 years, 11% between 50-59 years, 28% between 60-69 years,³ and about 46% in those 70 years of age and older.⁴ Hearing loss is associated with decreased quality of life independent of the auditory impairment, including increased risk of falls and dementia, and activity limitations which can lead to social isolation, anxiety and depression.⁵⁻⁶ Given the high prevalence of hearing loss, especially among older adults, it is important for dental hygienists to learn strategies to effectively communicate with patients with hearing impairment.

Dental professionals themselves may be at increased risk of developing hearing loss or tinnitus due to noise exposure sustained during clinical practice.⁷⁻⁹ While the potential for auditory effects from occupational exposure has been demonstrated in several studies, data are limited and often conflicting regarding the degree of risk for dental professionals, which may be affected by a variety of factors including duration of exposure, specific equipment used, and the setting and type of dental practice.¹⁰⁻²⁰ Studies suggest that the prevalence of hearing loss in dental professionals, based on self-report, is similar to national averages; however the prevalence of tinnitus has increased.⁹ One of the early studies reported temporary threshold shifts in dental students after equipment use.²¹ Current research suggests that these temporary threshold shifts may have long term consequences.²² Literature regarding hearing loss prevalence among dental professionals should be enhanced to better support its origins and severity.

There is a need to educate oral health professional students on the risks of noise exposure, in addition to providing guidance for caring for patients with hearing loss. Audiologists are trained to provide services regarding the identification, assessment, diagnosis, treatment, and prevention of hearing loss and balance disorders and are key members of the interprofessional management team for individuals with hearing loss.²³ As hearing health specialists, audiologists were ideal collaborative partners for a new curriculum initiative designed to engage dental hygiene and audiology students at the University of North Carolina, Chapel Hill. Objectives of this interprofessional experience included baseline hearing assessments for undergraduate and graduate dental hygiene students, and an informational session including an overview of the audiology profession, collaboration with audiologists, noise-induced hearing loss and protection,

and communicating with patients with hearing loss. The purpose of this study was to assess the quality and effectiveness of this new educational experience and to facilitate future curriculum improvement for the undergraduate and graduate dental hygiene education programs.

Methods

Collaborative Education Experiences

Project planning began with faculty members in the Audiology Program and the School of Dentistry (SOD) at the University of North Carolina, Chapel Hill. Objectives for the collaboration were to provide undergraduate (DH) and graduate (DHE) students with additional information and awareness related to noise-induced hearing loss and management of patients with hearing loss through a combination of clinical and didactic experiences. Hearing screenings, defined as a hearing test conducted at a fixed level to identify further comprehensive audiometric testing needs, were selected as the interprofessional clinical activity. Members of the faculty planning group designed the program to begin with the auditory screenings, based on the hypothesis that personal learner engagement might provide important context and readiness for the subsequent educational didactic session.

Senior DH and DHE students received an email detailing the program; interested students were provided with an opportunity to schedule an auditory screening. Students were informed that participation in the auditory screenings was voluntary, and that involvement had no impact on course grades. This pilot project was reviewed by the Institutional Review Board (IRB) at the University of North Carolina, Chapel Hill and was determined to be exempt. Five first-year audiology students in the School of Medicine's Clinical Doctorate in Audiology Program, supervised by one third-year audiology doctoral student and one faculty audiologist, performed the screening portion of the activity. All screenings were offered during a three-hour block of time on the same day, during a time that did not conflict with classes or clinics. Screening stations were set-up in a quiet seminar room.

Participants were screened at the level of 20 dB HL at frequencies of 1000, 2000, 4000, and 6000 Hz using conventional pure-tone audiometry. Otoscopy was performed prior to pure-tone audiometry and participants were informed immediately of any abnormal findings. If a participant did not pass at one or more frequency in either ear, tympanometry was also performed to assess function of the middle ear. An optional video otoscopy station was set up for interested participants to view their own ear canals. Students were provided with instructions in advance of the screening and their questions were

addressed. Informed consent was attained by volunteering and participating in the auditory screening.

A didactic presentation was delivered by a third-year audiology doctoral student during the required undergraduate DH course, special care in dentistry, one week following the auditory screening. The special care in dentistry course is designed to provide content for providing care to patients with special treatment considerations. Graduate DHE student participants were invited, but not required, to attend the class session. The following content was included in the presentation: the audiology profession, anatomy of the ear, prevalence of hearing impairment, components of the audiogram, consequences of hearing loss, types and levels of noise, types of hearing protection, work-related risks for dental professionals, effective communication for patients with hearing impairment, and how and when to make appropriate referrals to an audiologist. Students were engaged during the presentation and time was provided for questions and discussion.

Evaluation of Collaborative Education Experiences

Student surveys were created by the program collaborators to collect anonymous feedback from the DH and DHE students following the screening and didactic experiences. The purpose of the student feedback was to provide data to support the sustainability and expansion of the project, with suggestions on what to keep or change, and recommendations for the overall delivery, time allocated, and content for future students.

Participants were asked to rate their level of knowledge about the profession of audiology, hearing assessments conducted by an audiologist, noise-induced hearing loss, and communicating with patients who have hearing loss both prior to and following these educational experiences using a 4-point Likert rating scale from “not knowledgeable at all” to “very knowledgeable.” Students were asked to rate statements regarding the quality and value of the experience using a 4-point Likert scale from “strongly disagree” to “strongly agree.” Content area included questions on whether the audiology screening was well organized, a valuable learning experience, and contained important information for dental practice. Participants were asked if the activities increased their understanding of the importance of collaborating with other health professionals and if their comfort levels had increased for future collaborations with audiologists. Some of the survey questions were based on a similar project by James et al.²⁴ The survey also included two open-ended questions asking students to indicate the most

and least valuable aspects of this interprofessional education (IPE) experience. Surveys were reviewed by non-participant dental hygiene students and members of the planning committee and were revised prior to distribution.

A separate survey was created by the audiology faculty and the third-year doctoral student for distribution to the first-year audiology students who facilitated the screenings with the goal of quality improvement future audiology student participants. Questions were replicated from a larger survey used throughout the audiology program for interdisciplinary screening experiences. Survey questions focused on the value of the experience and suggestions for improvement and the statements were rated on 5-point Likert scale from “not valuable” to “very valuable.” Participants were also given the opportunity to suggest future interdisciplinary activities with the dental hygiene program. As the first-year audiology students did not participate in the didactic session, their survey focused solely the screening experience. and was administered electronically immediately following the activity. Survey completion was voluntary and responses were confidential.

Dental hygiene and DHE students were asked to complete a post-program survey and provide feedback following the didactic session. The survey was disseminated electronically via Qualtrics® survey software (Provo, UT) using an anonymous link; completion was voluntary and consent was attained by completion of the survey. The Wilcoxon Signed Rank Test was used to analyze participant’s reported retrospective ratings before and after the educational experience.

Results

Participation in the auditory screenings was high; a total of 37 (n= 33 DH; n= 4 DHE) auditory screenings were completed yielding participation rates of 94% and 67%, respectively. A total of 35 students (n= 32 DH; n= 3 DHE) completed the post-program survey for response rates of 94% and 50%, respectively. Eighteen participants indicated this was their first hearing assessment supervised by an audiologist. Eligibility, participation and response rates are shown in Table I.

Table I. Frequency and distributions of DH and DHE student participation in the auditory screening, didactic session, and post-survey

	DH students	DHE students	All
Enrolled	34	6	40
Received Auditory screening	33	4	37
Attended Didactic Session	30	0	30
Completed Survey	32 (94%)	3 (50%)	35 (87.5%)

The vast majority (97%) of the participants agreed or strongly agreed that the auditory screening session was a valuable learning experience. Furthermore, all (100%) of the respondents felt that the didactic lecture component contained important information for dental practice and nearly all (94%) would recommend that this learning experience be included in the dental hygiene curriculum. When considering the value of this experience from an interprofessional perspective, all (100%) respondents agreed or strongly agreed that this experience increased their understanding of the importance of collaborating with other health professionals. Responses related to level of agreement for the screening and/or lecture experiences are shown in Table II.

Table II. Percentage of DH and DHE students who rated each item “agree” or “strongly agree”*

	n	%
Students who participated in the Audiology Screening (n=33)		
The audiology screening experience was well organized.	33	100
The audiology screening activity was a valuable learning experience.	33	97.0
Students who attended the Audiology Lecture (n=30)		
The audiology lecture contained important information for dental practice.	30	100
All student participants (n=35, DH n=32; DHE n=3)		
This experience increased my understanding of the importance of collaborating with other health professionals.	33**	100
This experience will increase my comfort level when collaborating with audiologists in the future.	33**	100
I would recommend that this audiology learning experience be included in the Dental hygiene curriculum.	35	94.3

* Based on a four-point rating scale: strongly agree, agree, disagree, and strongly disagree

** Total number of responses to question n=33

Respondents’ self-assessment of their knowledge levels prior to and following the audiology intervention revealed changes in knowledge perceptions. Table III displays the results from the Wilcoxon Signed Rank Test demonstrating statistically significant changes in students’ knowledge perceptions ($p < 0.05$) based on their experiences with the project.

Open ended questions allowed DH/DHE students to add qualitative feedback. Participants were asked to provide the least valuable aspects of the audiology experience and to

describe how the quality can be improved. One participant stated, “I had to miss another class/commitment, so having multiple days to choose from for screenings would be great,” while another felt “everything was valuable.” When asked to share the most valuable aspects of the screening and lecture, comments included “how to communicate with patients with hearing loss,” “discovering your level of hearing,” “familiarity with audiology screening process and information on noise-induced hearing loss,” and “knowing the repercussions of not wearing hearing protection.”

Table III. Percentage of DH and DHE students who self-assessed their level of knowledge “moderately knowledgeable” or “very knowledgeable” before and after the audiology screening and/or lecture*

Level of knowledge about:	Before	After	p value
Students who attended the screening and/or lecture (n=35)			
The audiology profession	2.9%	85.7%	0.00
Students who participated in the audiology screening (n=33)			
Hearing assessment conducted by an audiologist	3.0%	84.8%	0.00
Students who attended lecture (n=30 DH)			
Noise induced hearing loss	3.3%	93.3%	0.00
Communicating with patients who have hearing loss	40.0%	93.3%**	0.00

* Based on a four-point rating scale: strongly agree, agree, disagree, and strongly disagree

** Prior to screening and didactic sessions, 40% of the students rated “moderately knowledgeable”, while after, 43.3% rated “very knowledgeable.”

Results from the separate audiology student survey provided additional data related to the value of the experience and suggestions for quality improvement. Four of the five audiology students (n=4) completed the survey for a response rate of 80%. When asked to rate their perceived value of this screening experience, 75% stated that it was somewhat or very valuable. Open ended suggestions regarding future interprofessional experiences included “having a dental school supervisor present to keep students moving through quickly and quietly,” “the opportunity to screen more students,” and “a small room for discussing results.” Positive comments included “the flow of the screening went very well... It was nice having the Firefly™” (Firefly Global, Beaumont, MA); a wireless video otoscope that captures and stores high quality images/video of ear canal and tympanic membrane to a computer for patient education. Insightful comments were also collected regarding presentations/experiences that

the audiology students would be interested in receiving from the dental program and included “info on how to care for our teeth, myths about teeth care,” “teeth whitening,” and “a discussion about craniofacial abnormalities that both audiologists and dentists would likely serve.” A final open-ended question asked for additional thoughts related to the experience. One participant suggested, “having a meet and greet with different professional health programs would be helpful in developing communication outside of disciplines.”

Discussion

Hearing loss is multifactorial and complex and can result in varying effects on individuals’ communication function and quality of life. Poor communication in healthcare settings related to hearing impairment can be especially problematic and may have significant adverse consequences similar to those related to low health literacy.²⁵ Missed or misunderstood healthcare information can lead to improper compliance with medications, scheduling and keeping requested appointments, preventive and pre- and post-surgical and other care instructions. Healthcare practitioners who understand the effects of hearing loss and use appropriate communication strategies can provide better patient care and facilitate audiology referrals if needed.²⁶⁻²⁷

Interprofessional collaboration in health care is critical as diagnoses and treatment are multifaceted and include a team of patient care providers. Teaching dental hygiene students necessary skills for appropriate care of patients with hearing loss may be more successful if IPE is part of the course design. Literature supports that interprofessional training of health care students can lead to the subsequent formation of collaborative practices following graduation.^{24,28} Interprofessional collaborative practice, supported by the World Health Organization (WHO), provides a team-approach to person-centered care, leading to enhanced patient outcomes and improved quality of care.²⁹ However, learning how to care for patients using a team approach needs to be taught as part of the health care professional education curriculum.

Learning with students from other health care disciplines who care for patients with hearing impairments may also serve to provide an improved understanding of the various professional roles and responsibilities, including one’s own, in providing comprehensive care for this population. These learning experiences could result in increased communication and referrals between professions, increasing the individual providers’ expertise and overall quality of patient care. Studies with physical therapy and audiology students using an interprofessional case-based learning experience in

the education of vestibular disorders demonstrated gains in confidence attributed to the collaborative learning design.³⁰ In another study James et al. aimed to promote hearing health through a collaborative IPE experience focusing on hearing assessments conducted by audiology and physician assistant students.²⁴ Results from this study indicated that offering interprofessional learning opportunities significantly improved perceptions of achievement of interprofessional collaborative sub-competencies that included increased knowledge of the other’s profession.

Understanding that hearing loss is an occupational risk for dental professionals can serve as a powerful preventive measure. If dental professionals are aware of the potential risks for hearing damage and loss, they may be more likely to recognize the early signs of hearing changes and also incorporate preventive measures, including the use of protective hearing devices during procedures with high noise levels and purchasing high-quality equipment that emits lower noise levels. Currently, little is known regarding the level of education that dental professionals receive during their training regarding noise-induced hearing damage. Goncalves et al. found the majority of dentists in their study had no training about noise and hearing thresholds and only half were knowledgeable about the harmful effects of noise on health.⁸ It is essential to include more comprehensive information about work-related injuries, beyond musculoskeletal disorders, to better prepare current and future clinicians with strategies to prevent the development and progression of hearing damage accumulated by exposure to frequent and high noise levels.

Limitations and Future Plans

This initial project involved one cohort of DH, DHE and audiology students and therefore, the findings may not be generalizable to other groups of students. However, because of the very favorable results, the team plans to continue these didactic and audiology screening activities for subsequent dental hygiene and audiology cohort groups. Additional project benefits included collaboration among faculty from two disciplines, establishing new networking opportunities and possible future collaborative efforts. Increased collaboration and the development of interprofessional educational designs can be applied to other health professions programs, with the ultimate goal of increasing student learning experiences, improved personal health awareness of students’ and ultimately better patient outcomes. Future plans also include an opportunity for the audiology students to visit the dental hygiene clinic to learn more about the dental hygiene profession.

Conclusion

This initial interprofessional educational activity was rated very favorably by the majority of the participants. Students reported increased levels of knowledge regarding the provision of dental hygiene care to patients with hearing impairment and regarding the profession of audiology. Participants also reported increased levels of comfort in collaborating with audiologists. From a personal health standpoint, dental hygienists and other oral health professionals are exposed to loud noises in clinical environments. Providing DH and DHE students with a baseline hearing screening can play a key role in identifying early issues related to hearing impairment and set the foundation for the use of protective measures to preserve hearing health throughout ones' professional career.

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Critical Issues in Dental Hygiene

Interprofessional Education in Dental Hygiene: Attitudes, barriers and practices of program faculty

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Abstract

Purpose: Interprofessional education (IPE) experiences are an essential component in preparing dental hygiene students to participate in future interprofessional (IP) collaborations to support comprehensive patient care. The purpose of this study was to determine the attitudes, barriers and IPE practices in a national sample of dental hygiene faculty.

Methods: A 25-item, researcher-designed, electronic survey was sent to 1,800 dental hygiene faculty members to determine attitudes, collaboration and practices involving interprofessional education (IPE). Descriptive statistics, Mann Whitney U and the Kruksal Wallis Test of Independent Samples were used to analyze and compare data.

Results: The response rate was 22% (n=449). Results suggest faculty have positive attitudes toward IPE and most faculty (73%) incorporated IPE in their programs; however, time constraints were reported as the greatest barrier to IPE participation. A majority (85%) of respondents indicated a desire for greater emphasis on IPE in the curricula. Ethics (37%) was ranked as the most important IPE competency and teamwork the least (19%). Respondents from bachelor's degree programs were more likely to agree that learning with students in other health professions helps students become more effective members of a healthcare team than those from associate's degree programs ($p = 0.025$). Additionally, respondents from bachelor's degree programs were less likely to agree that clinical problem solving can only be learned when students are taught within their individual schools than those from associate degree programs ($p = 0.022$).

Conclusion: Most of the dental hygiene faculty surveyed considered IPE important, incorporated it into student experiences, and wanted greater curricular emphasis on IPE. Time and institutional support may limit expansion of IPE activities and more collaboration amongst program faculty may be needed.

Keywords: interprofessional education, interprofessional collaboration, dental hygiene education, healthcare practice models, interdisciplinary teams

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Introduction

Interprofessional (IP) collaboration amongst healthcare professionals is an important healthcare practice model. Successful IP collaboration, to a large degree, is dependent upon effective interprofessional education (IPE). Defined as occurring when two or more healthcare professionals from different disciplines learn from, with and about each other, the goal of IPE is to improve the quality of patient care and promote team-based and patient-centered collaborative practice.¹ When delivering IP care, team members combine their individual expertise and observations into joint decision making. Individuals may assume patient care leadership

roles relevant to their discipline.² The importance of student engagement in IP learning has been promoted for many years.¹⁻⁷ Interprofessional care is ultimately a method to improve patient outcomes through coordinated care among a variety of disciplines. When given the opportunity to participate in IPE, student healthcare provider's skills may be strengthened and enhanced. Students who learn to appreciate and value working in an interdisciplinary team may be more prepared to collaborate across other disciplines as they engage in future practice settings.¹⁻³

Dental hygiene's involvement in IPE is an important aspect of the IP model. Given the preventive nature of the dental hygiene profession, coupled with oral-systemic links and healthcare provider shortages, dental hygienists should be integral members of IP collaborations. Dental hygienists must be able to communicate effectively when working with other primary care providers in the management of patients with chronic health conditions.⁷ Contemporary patients often present with complex health concerns and a variety of risk factors that can best be managed with an interdisciplinary approach.^{3,7} Dental hygiene education standards set by the Commission on Dental Accreditation (CODA) also recognize the need for IPE by requiring graduates to demonstrate competency in communicating and collaborating with other members of the healthcare team in order to support comprehensive patient care.⁸

While there are clearly benefits to IP healthcare, barriers and challenges to the incorporation of IPE into healthcare programs have been identified in the literature.^{2,9-12} Logistics of time and scheduling in an already crowded curriculum along with the lack of faculty development are frequently cited as IPE challenges from a variety of disciplines.⁹⁻¹³ In a study of respiratory therapy faculty the most frequently reported barrier was time, followed by attitudes toward IPE, scheduling and logistics, curriculum requirements and administration.¹² Amongst nutrition faculty members, attitudes were identified as the most common barrier followed by curriculum, resources and scheduling. Similar results concerning the perceived barriers in other health care disciplines were found by Dallaghan et al. and Hinderer et al.^{2,4} In dental hygiene, surveys of program directors report a lack of experience with IPE as the most common barrier followed by issues related to schedule coordination and curriculum.¹⁴ To address some of the challenges and barriers of IP collaboration, the World Health Organization (WHO) framework has provided strategies and ideals to assist professionals in designing and implementing team-approach, action steps.¹⁵

Four core competencies have been associated with IPE: collaborative practice; values and ethics, roles and responsibilities, communication, and team work.^{16,17} Values and ethics are related to working with individuals of other professions to maintain a climate of mutual respect and shared values. Roles and responsibilities are linked to the use of knowledge of one's own role and those of other professions to appropriately assess and address the healthcare needs of the population served.^{16,17} Communication is connected to effective interactions with patients, families, communities, and other healthcare professionals to support a team approach

to healthcare.^{16,17} Working as a team applies relationship-building values and principles of group dynamics to perform effectively in varying roles to plan and implement patient/population-centered care.^{16,17}

Quality oral healthcare can best be achieved when oral healthcare professionals work collaboratively with providers from other disciplines. A multi-professional approach, where dental hygiene students engage with other healthcare providers in the provision of primary care will likely improve patient health outcomes.^{3,7} Since education plays a critical role in the process of preparing future practitioners to successfully work together, understanding faculty attitudes and values towards IPE is relevant to today's educational model. While multiple levels of academic support are necessary for successful IPE implementation, ultimately it is the individual faculty members providing instruction and modeling positive attitudes towards IPE who will impact its success.^{2,4-7}

Research exploring the knowledge and attitudes of faculty toward IPE has been limited in dental hygiene literature. Furgeson et al., surveyed dental hygiene program directors in the United States (U.S.) and found only a little more than half (57%) of the respondents thought IPE was important for the dental hygiene profession with less than half (40%) indicating that it was important at their academic institutions.¹⁸ In a regional study, Casa-Levine investigated IPE attitudes and knowledge of dental hygiene faculty and administrators in the northeastern U.S.¹⁹ While the results were favorable toward valuing IPE, only about half of the respondents indicated that they were in the initial stages of using IPE; while only 6% were using IPE as part of a major initiative and almost one quarter of the respondents had not engaged in any type of IPE activities. Results from Casa-Levine indicate the need for a national study of dental hygiene faculty attitudes toward IPE be conducted to enhance the understanding of current IPE practices.¹⁹ The purpose of this study was to survey the attitudes, barriers and IPE practices in a national sample of dental hygiene faculty.

Methods

This study was determined to be exempt from Institutional Review Board (IRB) oversight by both Old Dominion and Augusta Universities. An electronic, self-report survey was distributed to the email addresses of 1,800 faculty members from the 335 entry-level dental hygiene programs in the U.S. obtained from the American Dental Hygienists' Association website. Individual faculty email addresses were obtained from the academic program websites. The initial recruitment email provided an explanation of the study and a link to the

anonymous web-based survey. Two reminders emails were sent at two and four weeks to increase survey return rate. Participants were given the option to either opt out of the self-report survey or agree to participate.

The survey instrument was a revised version of a validated survey by Vernon previously used to investigate IPE among respiratory therapists and nutrition faculties.^{12,13,20} Permission was granted to adapt the survey for use with dental hygiene faculty in entry-level programs. Feasibility and functionality of the survey instrument was pilot-tested with a random sample of nine full- and part-time dental hygiene faculty members; the survey was modified for clarity and length based on pilot-test results.

The 25-item survey instrument collected demographic information regarding the specific type of program setting (associate or bachelor degree granting, programs with or without a dental school), faculty appointment (full or part-time) and rank, program length (two, three, four years), enrollment, and amount and type of IPE activity. One question used a ranking system, (1=“most important” to 4=“least important”), to assess the importance of four specific IPE competencies (ethics, communication, roles and responsibilities and team work). Attitudes and beliefs regarding IPE education were assessed using a 5-point Likert rating system (1=“strongly agree” to 5=“strongly disagree”). Respondents were asked to rate (always to never) how often specific methods of instruction were used for IPE activities (case studies, on campus and off campus activities, simulation, service learning, standardized patients). One open-ended question asked participants to identify the barriers preventing them from implementing IPE. Data from this question were entered into a software application (TagCrowd, www.tagcrowd.com) to generate a pictorial description of word frequency in a word cloud with the word size proportional to its frequency as well as a numerical representation next to the individual word.

Qualtrics Survey Software (Qualtrics Labs; Provo, Utah) was used for the creation of the online survey and distribution. Collected data were downloaded and imported into SPSS 25.0. (IBM; Armonk, NY). Descriptive statistics were computed from closed-ended questions. Response differences between groups by program setting and degrees granted were tested by Chi Square, the Mann Whitney U Test and the Kruksal Wallis Test of Independent Samples ($p=.05$). Cronbach's alpha was conducted to determine reliability of the survey's edited attitudinal section.^{13,20}

Results

A total of 449 dental faculty ($n=449$) consented to participate for a response rate of 22%; however, 13% of respondents completed less than half of the survey and were not included in the analysis ($n=59$) for a final response rate of 22%. Demographic characteristics of the respondents and their associated programs are summarized in Table I. Respondents reported implementing IPE instructional methods (either in classroom, clinic, or community) ranging from one hour (30%), two hours (14%), three hours (5%), or four hours per week (26%); one quarter (25%) of the sample did not know how many hours were used for IPE instruction. Over half the sample (51.2%, $n=145$) reported having adequate time for IPE instruction. Instructional methods most frequently used separated by the degree granting categories and settings are shown in Figures 1 and 2. Methods of instruction did not differ significantly across groups. Most programs used either on-site or off-site clinical activities for IPE. The range of

Figure 1. IPE methods used most frequently by program setting

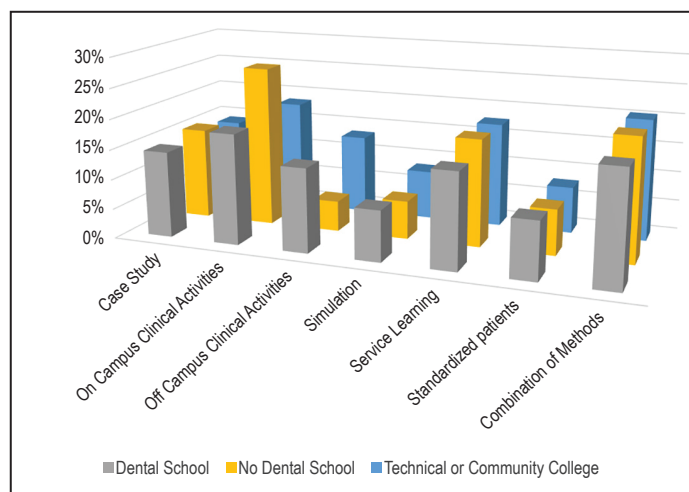


Figure 2. IPE methods used most frequently by degree awarded

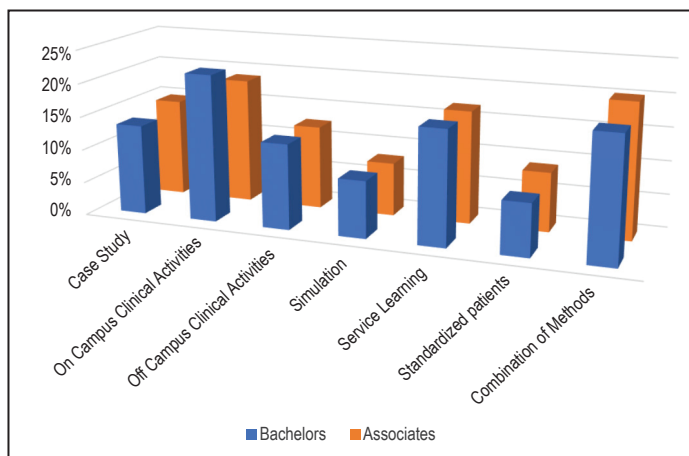


Table I. Program characteristics and respondent demographics

			Program type									
	Total n =390		Without a dental school n = 161		With a dental school n = 38		Technical/ Community college n = 191		Associate n = 305		Bachelor n = 81	
Program characteristics	(column %)		(row %)		(row %)		(row %)		(row %)		(row %)	
Enrolled students												
Less than 10	50	13	19	12	2	5	29	15	47	15	3	4
Between 11 and 15	179	46	56	35	21	55	102	53	149	49	30	37
Between 16-20	159	41	84	52	15	40	60	31	109	36	48	60
Degree awarded												
Associates	305	78	109	36	15	5	181	59				
Bachelors	81	21	49	60	23	29	10	13				
PNA	3	1	3	100	0	0	0	0				
Program type												
w/o dental school	161	41							109	36	49	60
with dental school	38	10							15	5	23	28
Technical/ Community college	191	49							181	59	10	12
Respondent demographics Rank												
Lecturer	121	31	42	26	4	11	75	39	104	36	15	19
Assistant professor	75	19	46	29	13	37	16	8	49	17	26	34
Associate professor	72	18	34	21	14	40	24	13	49	17	23	30
Professor	102	26	30	19	4	11	68	36	88	30	13	17
PNA	20	5	9	6	3	8	8	4	15	--	4	---
Faculty status												
Full-time	307	79	127	79	31	82	149	78	236	77	69	85
Part-time/adjunct	81	21	32	20	7	18	42	22	69	23	12	15
PNA	2	<1	2	1	0	0	0	0	0	0	0	0
Years teaching												
Less than 5	82	21	38	24	6	16	38	20	66	23	15	19
6 – 15	133	34	63	39	14	37	56	29	105	36	28	36
15 – 25	84	21	31	19	10	26	43	22	62	21	22	38
More than 25	72	19	20	12	6	16	46	24	57	20	13	17
PNA	19	5	9	6	2	5	8	4	15	--	3	--
Age												
25 – 34	28	7	15	9	4	10	9	5	19	7	8	13
35 – 44	65	17	29	18	4	10	32	17	55	19	10	13
45 – 54	100	26	36	22	10	36	54	28	77	27	23	29
55 – 64	147	38	59	36	14	37	74	39	116	31	31	40
65 and over	27	7	11	7	4	10	12	6	19	6	6	8
NA*	4	1	2	2	2	5	10	5	4	1	0	0
Gender												
Female	348	89	141	88	31	82	176	92	271	93	76	97
Male	23	6	11	7	5	13	7	4	19	7	2	3
NA*	19	5	9	6	2	5	8	4	15	--	3	--

*no answer given

Table II. Current interprofessional collaborations by program type and setting

Collaborating disciplines	Without dental school	With dental school	Technical/Community college	Associate	Bachelor
None	16	1	46	55	8
Nursing	91	30	100	165	56
Pharmacy	30	24	16	41	30
Respiratory Therapy	25	4	25	43	11
Physical Therapy	54	15	29	59	38
Occupational Therapy	46	16	23	55	30
Medicine	32	18	25	49	25
Other	65	4	49	92	29
Dental	62	31	69	119	41
Social Work	24	8	20	33	18
Speech Pathology	33	4	8	25	20
Counseling	18	1	13	25	7
Total	496	156	423	761	313

health disciplines collaborating with dental hygiene programs for IPE are shown in Table II. Nursing (65%, $n=221$) of responses was identified as the most frequent collaborator; no collaborating discipline was reported by 22 respondents.

Nearly three-fourths (73%, $n=281$) of the respondents reported incorporating IPE. However, the frequency of IPE activities was statistically different between the type of degree awarded and program settings; a larger percentage of bachelor degree granting programs reporting IPE inclusion ($X^2=8.739$, $p=0.013$). Programs associated with a dental school reported the highest degree of IPE inclusion (90%) ($X^2=18.07$, $p=0.001$). A majority (85%, $n=327$) of respondents agreed that they would like to see a greater emphasis on IPE in curricula, a finding that was not statistically different across the groups.

Faculty participants were asked to rank the IPE competencies of ethics, communication, roles and responsibilities, and teams and teamwork, from most to least important. Ethics was most frequently ranked as the most important competency (37%, $n=139$) followed by communication (23%, $n=88$) and roles and responsibility (21%, $n=79$). Overall, teams and teamwork ranked lowest (19%, $n=73$). Student competencies were ranked and grouped according to degree offered and program setting; however, differences in competency frequencies were not found to be statistically significant (Table III).

Attitudes towards IPE statements are summarized in Table IV. Mann Whitney/Wilcoxon tests indicated significant differences between faculty responses according to the type of degree offered at their institution. Cronbach's alpha revealed high internal consistency in regards to attitudes towards IPE (0.78), attitudes towards IP learning in the academic setting (0.74), and attitudes towards IP in healthcare teams (0.88).

Respondents reported general support for IPE inclusion. However, the Mann-Whitney test identified significant differences between the degree granting groups on three questions. Respondents from bachelor degree granting programs were less likely to agree that clinical problem solving can only be learned when students are taught within their individual departments/schools ($p=0.022$). While the majority (96%) of respondents agreed or strongly agreed with the statement "Learning with students in other health professional schools

helps students become more effective members of a healthcare team," respondents from bachelor degree granting institutions were more likely to agree with this statement as compared to faculty from associate degree programs ($p=0.025$). Kruksal Wallis Test of Independent Samples identified significant differences between program settings for the statement, "Patients would ultimately benefit if healthcare students worked together to solve patient problems." ($p=0.22$).

Attitudes towards IP learning in the academic setting were generally reported as favorable. However, 35% ($n=129$) of respondents were unsure whether there is room for additional IPE requirements in the current curriculum; this was significantly different between respondents from different program settings ($p=0.036$) with programs within a dental school more likely to agree. A majority of respondents (85%, $n=352$) either "strongly agreed" or "agreed", that faculty should be encouraged to participate in IP courses. In regards to the statement, "My program has the resources and personnel to teach IPE courses," respondents from bachelor degree granting programs and those located in dental school settings were more likely to report agreement than those from associate's degree programs ($p=0.002$), and those in settings outside of a dental school ($p<0.001$).

The majority of responses from both groups reflect support for IP practice in healthcare, by agreeing that participating in IPE among teams improves patient care decisions (95%), improves the

Table IIIa. Rankings of IPE competency importance by degree offered and Chi Square tests of group differences (associate, n = 296; bachelor, n = 80)

		Most Important	More Important	Somewhat Important	Least Important	X ²	p-value
Ethics	Associate	38%	19%	20%	23%	1.15	0.77
	Bachelor	33%	19%	24%	25%		
Communication	Associate	22%	39%	31%	8%	7.599	0.06
	Bachelor	26%	45%	16%	13%		
Roles and Responsibilities	Associate	21%	20%	27%	32%	6.177	0.10
	Bachelor	23%	14%	40%	24%		
Teams/Teamwork	Associate	19%	22%	22%	37%	0.137	0.99
	Bachelor	19%	23%	20%	39%		

Table IIIb. Rankings of IPE competency importance program type and Chi Square tests of group differences (without dental school, n = 156; with dental school, n = 37; technical or community college, n = 186)

		Most Important	More Important	Somewhat Important	Least Important	X ²	p-value
Ethics	w/o Dental School	38%	22%	19%	21%	4.912	0.55
	w/ Dental School	38%	8%	24%	30%		
	Tech/ CC	35%	19%	22%	24%		
Communication	w/o Dental School	23%	42%	27%	8%	5.675	0.46
	w/ Dental School	24%	43%	16%	16%		
	Tech/ CC	23%	38%	31%	8%		
Roles and responsibilities	w/o Dental School	21%	19%	31%	29%	7.044	0.32
	w/ Dental School	19%	22%	43%	16%		
	Tech/ CC	22%	18%	26%	34%		
Teams/teamwork	w/o Dental School	18%	17%	23%	42%	4.832	0.57
	w/ Dental School	19%	27%	16%	38%		
	Tech/ CC	20%	25%	20%	34%		

efficiency of patient care delivery (80%), improves quality with IP practice (97%). The most frequently identified barriers were time (n=190), programs (n=105), faculty (n=87), scheduling (n=74), curriculum (n=70), and students (n=55). Words describing barriers to IPE implementation were displayed in a word cloud (Figure 3).

Discussion

Results of this study are encouraging and important to future dental hygiene education and practice. Nearly three quarters of respondents reported that they are involved in some type of IPE with a little more than half indicating adequate instructional time in their curriculum, results similar to Casa-Levine who found about 75% of dental hygiene faculty surveyed in the Northeastern U.S. were involved with IPE.¹⁸ One-quarter of respondents reported teaching

IP collaborations for at least 4 hours per week. In a national study of U.S. dental hygiene program directors, Furgeson et al. found only 57% indicated IPE was important for the dental hygiene profession.¹⁹ However, in contrast, 85% of faculty in this study agreed that faculty should be encouraged to participate in IPE and almost all respondents (95%) believed that IPE improves patient care decisions, underscoring their belief in its importance. Differences in responses between faculty members versus program directors may be attributed to the administrative insights of program directors regarding challenges involved in implementing IPE into the curricula.

Inclusion of IPE activities was reported more frequently by programs granting bachelor's degrees and those located within dental schools. This finding is likely explained by increased opportunities for collaboration, as well as more resources

Table IV. Attitudes regarding IPE; Likert scale questions, all respondents (n=449)

	SA*	A*	NA/D*	D*	SD*
Attitudes towards IPE					
Clinical problem solving can only be learned effectively when students are taught within their individual department/school.	5%	12%	20%	56%	7%
Patients would ultimately benefit if health care students worked together to solve patient problems	60%	35.5%	3%	<1%	<1%
Learning with students in other health professional schools helps students to become more effective members of a health care team	63%	34%	2%	0%	<1%
Interprofessional learning among health care students will increase their ability to understand clinical problems	58%	38%	4%	0%	<1%
Interprofessional learning will help students to understand their own professional limitations	45%	43%	9%	3%	0%
Attitudes and beliefs about IP learning in the academic setting					
There are current curriculum requirements that could be removed to make room for additional IPE education.	6%	27%	34%	29%	4%
My program has the resources and personnel to teach IPE courses.	11%	36%	26%	26%	1%
Faculty should be encouraged to participate in interprofessional courses.	38%	56%	4%	<1%	0%
Faculty like teaching with faculty from other academic departments.	16%	40%	37%	6%	0%
Interprofessional efforts weaken program content.	1%	2%	11%	71%	14%
Interprofessional courses are logistically difficult.	15%	36%	29%	18%	1%
Attitudes toward IP in health care teams					
The give and take among team members helps them make better patient/client care decisions	32%	59%	9%	<1%	0 0%
The interprofessional approach makes the delivery of care more efficient	32%	48%	18%	2%	0%
The interprofessional approach improves the quality of care to patients/clients	46%	48%	5%	0%	0%
Team meetings foster communication among members from different professions or disciplines	43%	51%	6%	0 0%	0 0%
Working in an interprofessional manner unnecessarily complicates things most of the time.	3%	6%	28%	56%	7%

*strongly agree, agree, neither agree or disagree, disagree, strongly disagree

available in major healthcare centers where the programs most often cited as IP collaborators are located. The highest rates of IP collaboration were with nursing, occupational therapy, physical therapy, as well as intra-professional collaboration activities with dentistry. While the majority of faculty in this study indicated that there was inadequate time for IPE activities, 1 out of 4 respondents did not actually know how many hours are dedicated to IPE in the curriculum, suggesting a lack of IPE curricular knowledge amongst faculty members. This finding may be attributed to a lack of communication, or that only a small group of faculty were involved in IPE without input from other faculty members. The need for dental hygiene students to engage in IP learning experiences is critical as healthcare practice models evolve. In order to facilitate IPE, faculty may need to assume new instructional leadership roles and develop innovative curriculum.

Most respondents indicated they want a greater emphasis on IPE, demonstrating a recognition of the importance of team-based and collaborative care models and had the perception that the current curriculum falls short. Respondents most often reported the logistical barrier of “time” when describing IPE barriers. Word cloud frequencies highlighted curriculum, which is likely related to finding time for IPE in an already overloaded schedules and requirements. “Faculty” was also used as a word to describe IPE barriers, suggesting that respondents believed co-workers were less likely to support and engage in IPE than themselves. These findings are similar to other studies in both dental hygiene and other healthcare

disciplines.^{9-10, 20-22} Innovative curricular designs will be needed for many dental hygiene programs to find both the time and space for IPE activities.^{22, 23}

Faculty ranked ethics as the most important of the four IPE competences. In contrast, Vernon et al. found respiratory therapy faculty ranked ethics last, while in another study nutrition faculty ranked ethics second.^{12,13,20} This difference may be due to ethical practice being taught outside of IP collaborations. Communication was ranked second in importance indicating respondents valued the importance of responsive and responsible communication within the collaborative practice model. Teams and teamwork were ranked last in this study which was unexpected since dental hygienists are typically employed in clinical practice settings based on intraprofessional teamwork. This ranking in the context of IPE may be because many programs have practice management courses with a teamwork component. Previous studies have not ranked the specific IPE competencies by dental hygiene faculty members; however, Furgeson et al. found that dental hygiene program directors strongly supported the IP competencies in general.¹⁹

Significant differences, between faculty respondents in associate vs bachelor degree granting programs, regarding attitudinal statements were found in three areas. Respondents from bachelor degree granting programs were less likely to agree that clinical problem solving can only be learned when students are taught within their individual departments; more likely to agree that learning with other health professional students helps students become more effective members of a healthcare team; and more likely to agree patients benefit from group problem solving if healthcare students worked together. These findings might be related to program setting; bachelor degree granting programs might have more access to institutional resources than associate degree programs including the availability of more IP faculty and IP workshops.

Results demonstrated that most faculty respondents have favorable attitudes toward IPE, indicating while attitude is not a perceived barrier, nearly one out of four programs are not involved in IPE education. Understanding the barriers to implementation is important for wider incorporation of IPE, while also encouraging administrators to be more proactive in meeting the instructional needs of their faculty. In general, the majority of dental hygiene faculty respondents were supportive of teamwork, collaboration and communication through IPE for optimal patient care and improved quality of healthcare.

Limitations

Survey research has inherent bias related to the nature of self-reporting. Due to the anonymous nature of the study, it was not possible to evaluate each program individually which may have led to over sampling. Considering that there were significantly more respondents from associate's degree versus bachelor's degree programs, results may be biased due to the degree granting institution and program setting. The low response rate (22%) also limits generalization of the results; it cannot be assumed that these findings represent all U.S. dental hygiene educators. However, it is noteworthy that this response rate is higher than previously published studies with large sample sizes.²⁴⁻²⁷ Responses may be also be limited considering the online survey consisted of close-ended answers with the exception of one open-ended question related to barriers. While word frequencies displayed as a word cloud graphic for open ended questions does not provide evidence for thematic evaluation; they can be a useful first step in qualitative analysis. Future implementation of this survey is recommended to evaluate the sustainability and expansion of IPE collaborations, as well as identifying the attitudes and barriers within dental hygiene programs.

Conclusions

The need for IPE in dental hygiene programs is growing; collaborations with other healthcare professions are essential in an evolving healthcare system. Results of this study suggest that most dental hygiene faculty report positive attitudes toward IPE and a majority of programs are engaged in IPE activities at some level; however, barriers exist that may prevent expansion. Challenges of curriculum overload should be also be considered when addressing Commission on Dental Accreditation (CODA) standards. Faculty must be provided with sufficient training as well as time to plan and implement IP content in the curriculum to develop successful and meaningful IPE experiences that will contribute to contemporary healthcare delivery models.

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Nonmedical Use of Prescription Stimulants in Dental Hygiene Programs: Guidelines for prevention strategies

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Abstract

Nonmedical use of prescription stimulants (NPS), drugs frequently prescribed to treat Attention-Deficit/Hyperactivity Disorder (ADHD), is defined as the use of medications without a prescription or in a way that is inconsistent with a medical diagnosis. These pharmaceuticals are frequently prescribed to increase attentiveness, decrease distractibility, and improve daily functioning in individuals diagnosed with ADHD. While medically prescribed stimulants, including amphetamine, methylphenidate, and dextroamphetamine, have been shown to be safe and effective for improving the symptoms of ADHD, they have also been classified by the United States Food and Drug Administration (FDA) as schedule II, due to their high potential for abuse. With the increased matriculation of college students diagnosed with ADHD, the number of stimulants available on college campuses has risen substantially; and misuse of NPS is becoming a serious issue amongst college-aged students, including those in health care professions. The most commonly reported reasons for NPS use among college students is to improve alertness and concentration while studying and to enhance overall academic achievement. Borrowing, sharing and selling prescription stimulants between peers and friends are the common routes for NPS diversion. Academic performance expectations in dental hygiene education programs can create a highly stressful environment increasing the susceptibility of dental hygiene students to NPS misuse. Dental hygiene education programs should promote an awareness of the ethical, legal and overall health harms of nonmedical use of prescription stimulants.

Keywords: stimulants, nonprescription stimulant use, ADHD, health risks, dental hygiene students, college students

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Introduction

Scope of the Problem of Nonprescription Stimulant Use in Academia

Nonmedical use of prescription stimulants (NPS), drugs frequently prescribed to treat Attention-Deficit/Hyperactivity Disorder (ADHD), is defined as using medications without a prescription or in a way that is inconsistent with a medical diagnosis.¹ The purpose of this short report is provide a brief review of the literature on NPS use in academia, the legal and ethical issues regarding NPS amongst dental hygiene students and suggested best practices for addressing NPS use in dental hygiene programs.

The most widely prescribed stimulant medications include amphetamine, methylphenidate, and dextroamphetamine.^{2,3} Properly dosed, these medications increase attentiveness, decrease distractibility, and improve daily functioning and have been shown to be highly effective in the treatment of ADHD.³

While considered safe and effective treatment ADHD symptoms, this group of drugs are classified by the United States Food and Drug Administration (FDA) as schedule II, due to their high potential for abuse.⁴ Recently the FDA required manufacturers to place a “black box” warning on the medications highlighting the potential for serious consequences resulting from misuse including “sudden death and serious cardiovascular events.”⁵ Furthermore, the warning also identifies these drugs as having a “high potential for abuse” and warns against the possibility of individuals obtaining the medication for nonprescription use or distribution to other individuals.⁵

The prevalence of college students with a diagnosis of ADHD has been reported to range anywhere between 2% to 8% with prescription stimulants the first-line agents for treatment of the condition.⁶⁻¹⁰ As the ability to diagnose and effectively treat ADHD has increased significantly over the last

twenty years, so has the availability of prescription stimulants on college campuses and NPS use, particularly among college students.⁹ A study by Teeter et al. found that in a random sample of college students, 8% reported NPS use at least once in their lifetime, and nearly 6% had reported NPS in the past year,¹¹ however, Weyand et al. reported rates as high as 55%.⁶ Garnier et al. reported that nearly two-thirds of college students had been offered prescriptions for nonmedical use and nearly one-third reported NPS use by their fourth year of school.⁸

Research has shown the illicit use of stimulant medications is more prevalent among traditional students ranging from 18 to 24 years of age than among nontraditional students over the age of 25 years.⁴ It is also noteworthy that NPS use is not limited to college campuses in the United States (U.S.); increasing numbers of stimulant prescriptions globally has led to growing concerns regarding misuse in European countries as well as in Canada, Australia and Israel.¹² While much of the research on NPS use in young adults has been conducted on the general college student population,⁶ several studies have been conducted regarding use among medical students with lifetime use prevalence estimates ranging from 9% to 18%.¹³ Nonmedical use of prescription medications, specifically stimulants in addition to illicit drug was surveyed among health care professional students (medical, physician assisting and pharmacy) in the state of California.¹³ Nonmedical stimulant use was highest in physician assisting students (14%) followed by medical students (10%) and pharmacy students (6%).¹³ Reported NPS use amongst fourth year dental and senior dental hygiene students was found to be 12% in a population of students surveyed from the south-central region of the U.S.¹⁴

In general, college students engaging in NPS use frequently cite the need for an academic advantage as a reason for using stimulants without a prescription.¹ In the study by Teeter et al, students believed that stimulants would enhance concentration, assist with studying, and improve concentration.¹¹ However, in spite of the widely held student perception that NPS use increases academic performance and that stimulants are being used by the best students, a number of studies have questioned this assumption.¹⁵ Research has shown that college students engaging in NPS tend to have lower-grade point averages than non-users and did not demonstrate any detectable academic advantages over their peers.^{1,9,11} Another noteworthy finding from studies focusing NPS use in the general college student population, is the association of NPS use combined with heavy alcohol consumption and other illicit drugs.^{9,11}

In the study of NPS use among dental and dental hygiene students, the highly competitive, stressful school environment was considered a risk factor for using stimulants non-

medically.¹⁴ However, of the 12% of the respondents who reported NPS use, improved attention/concentration was cited by the majority (70%), followed by recreation (17%) and higher grades (13%) and there were no statistical associations between stress levels and NPS use in the population surveyed.¹⁴ In the study of health care professional students, a desire to “improve concentration/help focus” was cited as an important reason for NPS use.¹³

Drug diversion, the sharing, trading or selling of prescription medications among friends and peers, is the most common sources of NPS.³ A study of college students found that in a sample population of students with an ADHD diagnosis, over one-half (61%) had diverted their medications to someone without a prescription.⁸ In the McNeill et al. study of dental and dental hygiene students, 87% of the students engaged in NPS use and had obtained the medications from their friends.¹⁴ Classmates and friends were also cited as the primary sources of prescription stimulants by health care professional students.¹³ While there are ongoing concerns about future substance abuse and possible side effects including cardiovascular reactions and health complications related to NPS use, it is also important to emphasize the legal ramifications of drug diversion.^{15,16} Individuals are often unaware that it is illegal to sell or give away controlled substances, including prescription medications. Conversely, it is also illegal to obtain drugs that are outside of one's own medical prescription.¹⁵

Addressing Nonprescription Stimulant Use in Dental Hygiene Education

National studies have drawn attention to the problem of NPS on college campuses. While the literature on illicit NPS use among dental and dental hygiene students is limited to the McNeill et al. study,¹⁴ the general concerns regarding legal issues, future addiction, substance abuse and health complications in college student populations, should be taken into consideration in dental hygiene education programs.^{3,5-8} It is important to be aware of the overall prevalence of NPS use within the culture of the individual institution as a whole, in addition to developing departmental policies.^{15,16} A majority of health care students (87%) reported being aware that stimulants were being used at their institutions to enhance academic performance and over two-thirds (67%) believed that faculty were aware of the NPS use.¹³ Universities should have clearly stated policies on drug diversion and the nonmedical use of prescribed controlled substances such as prescription stimulants and consequences for illegal behavior should be clearly spelled out in student handbooks.¹⁵ Dental hygiene programs can mirror institution wide policies on

substance abuse in their individual departmental policy manuals.

In addition to addressing NPS use in university and departmental policy manuals, there are a number of ways the ethical and legal issues surrounding NPS use can be addressed within the context of the curriculum. The American Dental Hygienists' Association (ADHA) Code of Ethics for Dental Hygienists, can be used as a framework for discussing ethical dilemmas related to NPS use.¹⁷ Beginning with the basic premise of professional responsibility, stating that dental hygienists are responsible for maintaining a lifestyle that supports optimal health, students could discuss the impact of drug misuse on general health along with the legal and ethical ramifications of drug diversion. As future health care providers, students engaging in NPS use are violating ethical principles that apply to all health care providers. The core value of societal trust, comes into question when an individual chooses to illegally divert a drug or misuse a prescription medication. Addressing issues related to commonly held perception that NPS use is acceptable and safe behavior can be included in the context of the class discussion focused on professional ethical behavior.^{15,16} Veracity comes into question when one engages in obtaining and using a prescription drug illegally. Harming one's self through the health risks associated with NPS use violates the value of non-maleficence in that NPS use, while caring for patients, may increase their risk for harm.

Self-medicating through NPS use can also be seen from the moral perspective of performance enhancing drugs. In a study regarding the moral perspectives of NPS use by students, Verster and van Niekerk found that the cognitive enhancement therapies gained through prescription stimulants were considered to be acceptable for individuals with an attention deficit disorder.¹⁸ However, prescription stimulant use by individuals with the goal of cognitive enhancement was considered cheating, allowing users and unfair advantage and raises ethical issues similar to those encountered in athletics.¹⁸

Many dental hygiene programs engage in white coat ceremonies in which students officially receive a white coat before they begin to care for patients symbolizing their entrance into the health care profession. This rite of passage may include the reading of an oath and the acceptance of the professional responsibilities of becoming a health care

professional. NPS diversion and use breaks the fidelity to this promise. However, since many health care professional students engage in NPS use for academic purposes, rather than to obtain a high as with other illicit drugs, they often overlook the implications of abusing a schedule II, controlled medication.^{13,19}

Possessing a controlled substance without a valid prescription is a violation of the law and individuals found to be guilty may be sentenced to serve a term of imprisonment of not more than 4 years.¹⁹ Drug and alcohol convictions could result in being dismissed from a dental hygiene program. Previous convictions must be also be disclosed in dental hygiene licensure applications and may prevent a candidate from receiving a license to practice.

Best Practices

There is a need for dental hygiene faculty members to better understand the rationale for NPS use amongst students and develop strategies to ultimately reduce the risks of prescription stimulant misuse in dental hygiene education programs. The nonmedical use of prescription drugs should be viewed within the larger context of the college or university substance abuse and mental health programs.¹⁵ Incorporating NPS use into campus drug prevention initiatives begins the discussion on the fact that NPS use is just as illegal, unethical, and detrimental as any other illicit drug, and that the same consequences as outlined in the university policy manual apply to NPS use. This education can be done through online modules immediately following acceptance into dental hygiene school and/or during orientation.

The ethical and moral aspects of NPS use for the purpose of enhanced cognitive abilities should be considered in the institution's academic honesty policies and fall under the same category of disciplinary procedures as any other illicit substance. Dental hygiene programs can consider adding academic honesty statements incorporated into each examination. A sample academic honesty statement is shown in Figure 1. Dental hygiene students should understand that the consequences due to cheating will be the same, regardless of the method used.

Figure 1. Academic honesty statement

I attest to the following statements:
I will not use any non-instructor approved notes, or electronic device for assistance on this examination.
I will not receive any assistance from my peers on this exam, nor will I give any assistance to my peers on this examination.
I will not remove this examination from the room, nor will I discuss this examination with my peers who have not yet taken it.
I have not abused any prescription drugs or non-prescription drugs that may influence my performance on this examination.
I understand that that any form of academic dishonesty may be penalized to the full extent of the university in addition to failure of this examination.

It is imperative for students, faculty members, staff, and administrators, within dental and dental hygiene programs to become aware of the potential risks, legalities, and ethical issues with the misuse of stimulant medications and implement best practices in order to monitor NPS use and promote a drug-free environment.

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An Oral Health Education Training Intervention: A pilot study with Haitian schoolteachers

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Abstract

Purpose: Risk factors for oral disease are elevated among disadvantaged populations living in developing countries; rural Haitian school children have limited or no access to health care services. The purpose of this pilot study was to assess Haitian schoolteachers' attitudes and knowledge on oral health prior to and after attending an oral health educational intervention as well as their perceptions and experiences of receiving and implementing oral health education in a Haitian classroom setting.

Methods: This mixed methods study used a quantitative, quasi-experimental, one-group pre/post-test design, before and after a 3-day oral health educational training in Borel, Haiti. A validated pre-and post-test questionnaire measured changes in oral health knowledge and attitudes. A qualitative, phenomenological approach was used to analyze information gathered during focus groups, using a semi-structured interview guide, to explore schoolteachers' perceptions and experiences regarding the training intervention and the six-week implementation of the oral health curriculum.

Results: A purposeful sample of nine Haitian primary schoolteachers (n=9) consented to participate in the study. Oral health knowledge and attitude mean scores of the participants demonstrated improvement from pre-test (70%) to post-test (78%) scores. Qualitative findings revealed two major themes; confidence and empowerment, and improved oral health knowledge and hygiene behavior.

Conclusion: Quantitative results from this study confirmed that training Haitian schoolteachers to integrate oral health education in the classroom can be an effective method for improving schoolteachers' personal oral health knowledge and attitudes. Findings also revealed a positive outlook on the training intervention and the application of an oral health education curriculum in the classroom. Results from this study provide a foundational knowledge for future oral health education trainings in underdeveloped countries with limited resources.

Keywords: oral health education, oral hygiene, health promotion, vulnerable populations, public health interventions

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Introduction

Oral diseases are a public health issue world-wide and are ranked as the most common and preventable non-communicable disease among children and adolescents.¹ The World Health Organization (WHO) estimates that dental caries affect 60% to 90% of school aged children,² and oral health issues contribute to a loss of 50 million school hours each year.³ Childhood dental diseases, such as dental caries and gingivitis can lead to physical pain and dysfunction; subsequently effecting a child's psychological and social well-being.¹

Oral health status inequities within a population are intensified by social, environmental, biological, behavioral,

cultural, economic, and political factors.⁴ Risk factors for oral diseases are increased due to consumption of foods and beverages containing high levels of sucrose, lack of fluoridated water supplies, poor oral hygiene habits, limited access to dental care, and limited oral health literacy.^{1,2,5,6} Social determinants leading to poor oral health are elevated among disadvantaged populations living in developing countries.⁵

Access to health care services on the country of Haiti is limited.⁷ Most medical and dental clinics are located in the country's capital of Port-au-Prince, creating access issues to available health care services for rural areas.⁷ According to a

2010 report from the United Nations International Children's Emergency Fund (UNICEF), an estimated 60% of individuals living in rural Haiti had no access to health care services.⁸

Haiti has the lowest dentist-to-population ratio in the Western hemisphere; with a ratio of 0.12 dentists per 10,000 residents to provide oral health care services.⁹ Economic and financial hardships present limitations for many Haitians and routine dental care is not a common occurrence.⁷ Lower rates of oral health literacy among Haitians and limited access to dental care increase the risk factors in children for developing oral diseases.⁷

The availability of current published peer-reviewed research on oral health related literature in Haiti, particularly regarding the oral health status of children and adolescents, is lacking. A national epidemiological study on dental caries in Haiti conducted in 1999, observed the oral status of 1,218 adolescent children at 12 and 15 years of age, noting the decayed, missing, filled surfaces (DMFS).⁹ Results from the study identified decayed or missing teeth in 30% of the 12 year-olds and 46% of the 15 year-olds.⁹ Decay rates were highest among rural participants as compared to those from urban areas.⁹ Additional gaps in the literature revealed no knowledge regarding implementation of school-based oral health programs and the influence of these programs.

Haitian culture places a high value on childhood education, with the vision that children are the foundation for Haiti's future.¹⁰ Children are influenced at a young age by positive health behaviors, and school can be an optimal setting for children to receive oral health information when it is integrated into the curriculum.^{1,3,11} Schools in underdeveloped countries can provide a useful platform for educating children about oral health promotion,¹¹ as an appropriate means for preventing future dental disease.^{1,3,11}

Schoolteachers in underdeveloped countries may have limited oral health knowledge and training, and thus be ill equipped to teach oral health education in the classroom, until receiving professional training on the subject.¹²⁻¹⁴ In addition, teachers often lack any oral health educational materials for this purpose.¹²⁻¹⁷ Training schoolteachers on how to implement oral health education by incorporating learning activities to the existing curriculum can be an inexpensive and feasible means for teaching children important oral health concepts.^{3,11,18} Improving teachers' oral health knowledge not only increases their ability to provide school-based oral health education, but can also lead to improved personal attitudes toward oral health and overall health behaviors.^{2,11,15-20} Effectively advancing the oral health knowledge of schoolteachers while also providing educational materials, may be achieved through teacher training sessions.^{11-14,21}

The perceptions of schoolteachers who have been trained to provide oral health education and their experiences teaching oral health education to students has not been extensively researched.^{11-14,21} Qualitative research may provide insight into the oral health problems and assist in identifying the barriers and opportunities for providing school-based oral health education programs to disadvantaged populations, such as the children of Haiti.^{22,23} The purpose of this study was to assess Haitian primary school teachers' knowledge and attitudes about oral health before and after attending a three day oral health educational training session and their perceptions and experiences of receiving and implementing oral health education in a Haitian classroom setting.

Methods

Borel, Haiti is nestled in the Artibonite Valley, approximately 36 miles north of Haiti's capital, Port-au-Prince. James Wallace School is located in Borel with over three hundred children enrolled in pre-kindergarten through sixth grade. At the time of this study, there was no oral health education being taught in classrooms at James Wallace School or the surrounding area.

This pilot study used a mixed methods design consisting of a quantitative, quasi-experimental, one-group pre/post-test following an oral health education intervention. Additionally, a qualitative, phenomenological approach was employed to assess participant experiences, after six-weeks of implementing oral health education in the classroom. A non-probability, purposive sample of schoolteachers was chosen for the study; which included primary grade teachers who speak Haitian Creole as their primary language, teach at James Wallace School, and live in Borel, Haiti, or in the surrounding areas.

This study was approved by the Massachusetts College of Pharmacy and Health Sciences (MCPHS) University's Institutional Review Board (IRB), IRB022715R. Written and verbal consent in the Haitian Creole language was provided and secured from the participating teachers prior to the start of the study.

A dental professional provided oral health education to the study participants over the course of one week, using a Haitian Creole interpreter. Participants attended a total of three, two-hour oral health educational sessions and also received oral health-related promotional and educational classroom materials appropriate for children 5-12 years of age. Following the completion of the training sessions, study participants were asked to provide oral health education in the classroom over a six-week period of time.

The topics, presented orally in two-hour training sessions over three-days, were aligned with the recommendations for

school oral health education established by the WHO^{19,21} and also included handouts in Haitian Creole. Hands-on demonstration methods were used, and schoolteachers had opportunities to practice teaching techniques using dental models including a child's storybook about dental and body hygiene, a flannel graph for younger children, a magnet board with a variety of enlarged pictures for dental health education. Participants were provided with grade-appropriate health promotional posters; one set of materials was designed for pre-kindergarten through third grade and another for fourth through sixth grade.¹⁹ All educational materials used for the demonstration segment were donated to the school for teacher use.

A questionnaire, developed and validated by Haleem, et al.²⁴ was administered for data collection prior to and following the schoolteacher participants' completion of the oral health educational training modules. The twenty-item questionnaire was translated into Haitian Creole; six additional demographic questions were completed at the time of the pre-test assessment. The pre- and post-test questionnaire included six attitude-based questions, and 14 dental health knowledge questions.

Following the oral health educational intervention, participants implemented the oral health education sessions consisting of three basic oral health lesson plans, in their classrooms over a six-week period. Qualitative data was collected, six weeks following the oral health education implementation, using a two-hour semi-structured focus group session, and consisting of six open-ended questions with a Haitian Creole interpreter present as a translator. In addition, the primary investigator (PI) took field notes and used a digital audio recording device during the focus group interviews to ensure reliability in transcription when evaluating the phenomenological data.

Responses to the 14 dental health knowledge-based pre- and post- intervention questions were enumerated in the form of descriptive statistics. Mean scores (out of 100%) were enumerated over the study population, with exact binomial 95% confidence intervals. Mean responses to the six attitude-based Likert scale questions (strongly disagree -2 to strongly agree +2:) were enumerated, mean differences in pre and post responses were enumerated with 95% Wald confidence intervals.

Field notes and audio-recorded transcription were compared for accuracy to ensure data credibility for the qualitative findings. The CREATIVE approach described by Pitney and Parker²⁵ was employed to analyze the discussions from the focus group, and to identify emergent themes. CREATIVE, is an acronym for: *consider* the research questions and purpose: *read* through the transcripts to gain a better

sense of the data: *examine* data for important information related to the research question: *assign* labels to each unit of information that capture their meaning: *thematize* the data: *interpret* themes as they relate to the study's research question and purpose statement: *verify* the findings: and *engage* in the writing process to describe the findings.²⁵

Results

Ten Haitian schoolteachers from the James Wallace School were recruited for the study and all agreed to participate in the oral health education training sessions and the six-week follow-up focus group session. One participant was excluded from the final analysis as a result of not meeting inclusion criteria (being a teacher at James Wallace School). Data were collected from the pre- and post-test outcomes, as well as the focus group responses of the study population (n=9). The mean age of the participants was 42.1 years; one-third of the participants were male.

Pre-and Post-Test Questionnaire

Table I presents the 14 dental health knowledge-based questions from the pre- and post-test. The Haitian schoolteachers' overall mean test scores improved from the pre-test (70%) to the post-test (78%). Dental health attitudinal question responses to the six Likert scale items shifted in a positive direction as indicated in the pre- versus post-test results (Table II).

Focus Group Themes

The results from the study's focus group provided knowledge on the perceptions and experiences of the Haitian schoolteachers who attended the oral health education training intervention, and the implementation of the oral health education curriculum into their classrooms. Qualitative findings in the study revealed two major themes; confidence and empowerment and improved oral health knowledge and hygiene behavior. Emerging themes described how the oral health education training and curriculum advanced participants' knowledge confidence on the subject, and fundamentally motivated the students to learn about oral health as well as a desire to improve their own oral health. The following themes reflect the participants' perceptions and experiences with the oral health education training intervention and the implementation of the oral health education curriculum in the classroom.

Theme 1: Confidence and Empowerment

Participants discussed the sense of confidence and empowerment the oral health education curriculum created for their professional growth. The oral health education training

Table I. Dental health knowledge questions (n=9)

Question	Correct Responses Pre-test (%)	Correct Responses Post-test (%)
1. Do you think that tooth cleaning is a part of general body cleanliness?	8 (89%)	9 (100%)
2. Is it easy for you to clean your teeth at bedtime every day?	7 (78%)	9 (100%)
3. How many times in one day do you clean your teeth?	9 (100%)	9 (100%)
4. What do you use to clean your teeth?	9 (100%)	9 (100%)
5. Do you use anything containing tobacco?	9 (100%)	9 (100%)
6. At what age does the first permanent molar tooth erupt in a human's mouth?	0 (0%)	7 (78%)
7. What is the total number of milk teeth in a human's mouth?	1 (11%)	3 (33%)
8. What is the total number of permanent teeth in a human's mouth?	8 (89%)	8 (89%)
9. Which of the following is the most important thing to be included in a toothpaste or miswak for healthy teeth?	7 (78%)	8 (89%)
10. What is the most common cause of gum disease?	6 (66%)	2 (22%)
11. What is the first most important sign of gum disease?	6 (66%)	6 (66%)
12. What is the most important sign of tooth decay?	4 (44%)	2 (22%)
13. Which of the following pair of preventive measures can protect you from tooth decay?	9 (100%)	8 (89%)
14. Consuming tobacco-containing products cause which of the following pair of diseases?	5 (56%)	9 (100%)
	Average Score Pre-test*	Average Score Post-test*
	70% (62%, 77%)	78% (67%, 89%)

*95% confidence interval

sessions enabled teachers to develop skills and willingness for implementing the oral health education curriculum in the classroom. The majority of the schoolteachers expressed an ability to confidently teach and answer oral health questions from the students. Participant 6 exclaimed, "I [teach the way] you taught us, to the kids." Participant 9 stated, "Every question that they ask, [the teachers] know the answer to it."

Participants expressed feeling comfortable with the oral health module because they had picture visuals and hands-on models aligned with the curriculum. Participant 2 explained, "It was very helpful because I have the pictures. If I am

talking about cavities, I can show the kids the cavity and the tooth and how to take care of it." Participant 1 added, "I feel comfortable because I was teaching the kids how to brush their teeth and stuff like that and I also have the materials to show them the pictures."

Theme 2: Improved Oral Health Knowledge and Motivation

When participants were asked if the oral health training sessions met their expectations to prepare them on the topic of oral health, the schoolteachers unanimously agreed they learned new techniques on how to prevent decay. Participant 6 noted, "You taught me how to brush teeth well enough to prevent cavities."

Additionally, participants believed the students learned about oral health and disease prevention from the oral health education curriculum. Participant 2 stated, "[The students] learned how many teeth they have and to prevent cavities, not to eat a lot of sugar, coke and stuff like that." Participant 9 added, "They know when a tooth is happy and when a tooth is sad and they smile." Participants stated that several students inquired about their own concerns for their bleeding gingiva or tooth pain and the teachers were able to explain how to prevent gingival bleeding. Participant 7 stated, "In my class, I find like eight students that have problems like gums bleeding and pain in their teeth and I taught the students how to prevent these things, how to get rid of it and how to brush and not bleed."

Participants collectively noted when using picture visuals and hands-on materials, the students were motivated to learn. Participant 4 noted, "When the students saw the materials they were very happy, they like the pictures." Participants expressed that students were excited to tell the teachers that they had brushed their teeth. Participant 9 noted, "Every morning the students come up to me and say, 'Oh, look, look, I brushed my teeth last night!'"

Table II. Responses to Likert-scale* Dental Health Attitude Statements (n=9)

Statement	Pre-Training Mean Rating (SD**)	Post-Training Mean Rating (SD**)	Mean Difference (95%CI***)
Dental health education is the job of the dentist and has got nothing to do with the teachers/peer leaders.	-0.63 (1.06)	-0.57 (1.13)	0 (0,0)
No matter how careful a person may be, he/she is bound to lose teeth in old age.	0.71 (1.25)	-1.33 (1.32)	-1.86 (-3.58,-0.13)
In order to have a healthy body one must have healthy teeth.	0.44 (1.24)	1.67 (0.50)	1.22 (0.38, 2.06)
Tooth cleaning should be a part of daily body cleaning activities.	1.67 (0.5)	1.56 (0.53)	-0.11 (-0.57, 0.38)
Dental check-ups can be carried out in classes by teachers or trained peer leaders on a routine basis.	1.11 (0.93)	1.56 (0.53)	0.44 (-0.33, 1.22)
Teeth can remain healthy throughout one's life if proper preventive measures are taken.	0.22 (1.48)	1.78 (0.44)	(0.40, 2.72)

* -2 = strongly disagree, -1 = disagree, 0 = neutral, 1 = agree, 2 = strongly agree

** Standard deviation

*** Wald confidence interval

Conclusions drawn from the focus group noted a readiness to continue implementing the oral health curriculum module in the classroom. Participant 6 stated, “Yes, I am ready to continue teaching this oral health education curriculum.” Additionally, participants expressed they want more training in oral health education. Participant 2 agreed, “Yes, we want more knowledge.” The schoolteachers discussed the need to have more oral health educational resources to support their teaching efforts. Participant 3 explained, “I would suggest each of us have our own picture materials, that way we don’t have to wait for others to take a turn.”

Discussion

A number of international studies have shown that implementing teacher-led oral health education at the primary and secondary grade levels is both a feasible and effective method for improving the oral health knowledge and oral health status of school-aged children worldwide.¹⁸⁻²⁰ Training schoolteachers to integrate oral health education with dental health promotional materials in the classroom has also been shown to improve personal oral health knowledge and demonstrate positive shifts in attitudes, which in turn has a positive impact on students.^{12-14,19} The intervention in this study provided training to Haitian primary school teachers, pre-kindergarten through sixth grade, with the goal of introducing and encouraging the implementation of an oral health education curriculum in the classroom. Similar to findings in previous studies,^{12-14,19} improvements were noted in the Haitian schoolteachers’ oral health knowledge and attitudes as a result of attending the training intervention.

Although this study did not measure the effects of the oral health education program on Haitian school children, the intervention provided a sufficient route for Haitian students to receive appropriate teacher-led oral health education using relevant visual aids and other hands-on educational materials. Future endeavors to measure the effects of teacher-led oral health education on Haitian school children’s oral health knowledge and practices, should benefit from this initial research determining the efficacy of teacher oral health education training.

A knowledge response from the dental health questionnaire should be further evaluated. Item number ten inquired about the most common cause of gingival disease. A majority of the respondents answered this question incorrectly (88%, n=7) on the post-test. This incorrect response could be due to the overall volume and content of the oral health education during the training intervention, or due to a focus on dental caries etiology and prevention. Future education interventions should address the need for more clarity in this area.

Previous studies utilizing oral health education seminars or workshops for training school teachers on school-based oral health education have echoed consistent outcomes of improvements in teachers’ oral health knowledge and attitudes.^{12-14,19} Similarly, the intervention applied in this study produced quantitative data reflecting overall improvements in teachers’ oral health knowledge as well as a change in their attitudes toward oral health.

Qualitative data gathered from the focus group session in this study adds to the depth of emerging information known regarding teacher-led oral health education in underdeveloped countries, specifically Haiti. The information gained by the Haitian schoolteachers and the feeling of empowerment from the training, may have a positive impact on the oral health behaviors of current and future Haitian students receiving the teacher-led oral health education module. Ramroop, et al.¹⁶ described barriers to implementing a teacher-led oral health education curriculum resulting from limited teacher training and a lack of educational materials. Holding three separate training sessions that were two hours in length and the use of visual display materials allowed for increased learning in this education intervention. Participants in this study suggested improving training sessions by offering oral health education sessions over the summer vacation to allow for more training time. Based on this feedback, it may be advisable for future training opportunities to take place during the summer timeframe. An additional classroom implementation barrier identified by the participants was only having two sets of grade appropriate picture visuals and hands-on dental models available for teaching the curriculum. Analysis of these comments suggest the need for additional reproduction of the picture visuals and hands-on dental models for different age groups and academic levels for future oral health education training sessions.

Limitations

Generalizing the results from this study are limited by several factors, including the lack of a control group, the application of a non-probability, purposive sample, and the small sample size (n=9). This study's pre- and post- test questionnaire applied a Likert-type scale for six questions measuring oral health attitude. In Haitian culture, a Likert-type scale rating is not a common scale for answering questions. Unfamiliarity with this type of scale may have skewed some of the results. The school setting also provided a limitation, as there was no electricity for presenting video or computer based educational recordings during the intervention. Additionally, due to the nature of a focus group, participants may have not felt comfortable sharing their perceptions in front of others and therefore, bias may exist among the participants' responses. Lastly, the short follow-up time of six weeks post- intervention and one focus group does not determine the sustainability of the school's implementation of the oral health education curriculum.

Conclusion

In conclusion, the quantitative results from this study were consistent with previous studies, confirming that training schoolteachers to integrate oral health education

in the classroom can be an effective method for improving personal oral health knowledge and attitudes. Evaluating the schoolteachers' perceptions and experiences with the oral health education training intervention, and implementation into the classroom has provided foundational knowledge for improvement in future oral health education trainings. Although this study did not evaluate the overall effects of the teacher-led oral health education of the Haitian school children, it provides information regarding the success and barriers to Haitian schoolteacher training and the implementation an oral health education curriculum. Further research is needed to determine the benefits of the teacher-led oral health education on primary school aged children in Haiti.

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Hypodontia, Oligodontia and Anodontia in West Virginia Appalachia

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Abstract

Purpose: Children in West Virginia have a high prevalence of missing permanent teeth when compared to children in the rest of the nation. The purpose of this study is to determine the prevalence of permanent tooth hypodontia/oligodontia/anodontia in West Virginia children and to compare the prevalence by sex.

Methods: Five hundred panoramic radiographs of West Virginia children, ages 6-11 years, were examined for missing permanent tooth buds/permanent teeth. Data analyses included frequency determinations, Chi square analyses, and logistic regression.

Results: Sixty children (12.0%, n=500) had at least one missing permanent tooth bud/permanent tooth. There were 15.5% of females and 8.8% of males who had at least one missing permanent tooth bud/permanent tooth. In adjusted logistic regression on at least one missing permanent tooth bud/permanent tooth, females had an adjusted odds ratio of 2.11 [95% Confidence Interval: 1.18, 3.75; $p = .011$] compared with males. Other variables in the analysis failed to reach significance.

Conclusion: In this sample of West Virginia children, females were more likely to have at least one missing permanent tooth bud/permanent tooth compared to males. Early recognition and treatment planning for dental care is needed for children with hypodontia/oligodontia/anodontia.

Key words: missing teeth, hypodontia, oligodontia, anodontia, West Virginia, Appalachia

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Introduction

Dental agenesis, the failure of a tooth to develop, is a developmental condition with a worldwide prevalence of approximately 5%, and a North American prevalence of approximately 3.9%.¹ Reported prevalence levels vary widely, ranging from as low as 0.3% to as high as 36.5%.¹ Females are more likely to have dental agenesis than males,^{1, 2} and time trends have also been reported.¹ The affected tooth/teeth varies with race/ethnicity as well as locale. For example, European descendants have premolars as the most affected teeth; Japanese descendants have mandibular central incisors as the most affected teeth; and in the United States (U.S.), the maxillary lateral incisors are the most affected teeth.³

The phenotype of dental agenesis is described with the following terminologies: *hypodontia*, the absence of 1-5 teeth, excluding the third molars; *oligodontia*, the absence of 6 or

more teeth, excluding the third molars, but not all teeth; and *anodontia*, the absence of all teeth. Since the manifestation of the phenotype occurs after birth, the use of the terminology, “congenitally missing tooth/teeth” (indicating occurrence/presence at birth), has been questioned.^{2, 3}

Development of the primary teeth begins at approximately 6 weeks gestation with a thickening of ectodermal tissue into dental lamina and its invagination into neural-crest derived mesenchyme.⁴ Six connected maxillary placodes and six connected mandibular placodes progress through the bud stage, to the cap stage with the development of an enamel knot by 10-13 weeks gestation.⁵ If the cap is destined to be a primary central incisor or primary first molar, the dental lamina will grow posteriorly from it (continual dental lamina) to develop a primary lateral incisor bud or primary second molar bud.

Permanent molar buds develop from the continual dental lamina from the cap of the primary second molars. Successional dental lamina forms from the lingual of the dental lamina near the primary incisors, canines, and molars⁵ for the eventual development of tooth buds for permanent incisors, canines, and premolars. Genetic and epigenetic influences affect tooth development throughout the stages.^{3, 6-9}

Tooth development may be affected by interference in any of the signaling pathways regulating the process. At least 150 syndromes⁸ and conditions are associated with missing teeth including ectodermal dysplasias, Rieger syndrome, cleft syndromes,⁵ taurodontism, and Down.⁷ Interference can occur if there is a failure to initiate formation, a reduction in the odontogenic potential for the dental lamina, or arrested development during an early stage such that the last tooth in a tooth family fails to develop, explaining the commonly missing second premolars and lateral incisors.⁵ Factors during pregnancy such as smoking,¹⁰ rubella, maternal diabetes,⁹ and drugs,⁷ have been associated with dental agenesis. Additionally, environmental insults from trauma (luxation/avulsion of primary teeth), therapeutic radiation, ingestion of chemicals, prematurity/low birthweight, severe malnutrition, neonatal hypocalcemia, vitamin D deficiency, bilirubinemia, thyroid and parathyroid disturbances, neonatal asphyxia, severe infections, and metabolic disorders have the potential to arrest the development of permanent tooth germs.⁹

West Virginia is a state with all 55 of its counties included as part of the U.S. Congressionally defined Appalachian region. This 420 county-wide area is served by the Appalachian Regional Commission to increase the overall opportunities and quality of life. West Virginia has many health-related challenges, particularly related to oral health and current oral health data is limited. Although the 2014 West Virginia Behavioral Risk Factor Surveillance System Report addressed adult oral health need in the area, the oral health needs assessments data concerning children were not available.¹¹ A recent literature search provided one study of oral health needs, however it was limited to orthodontic need.¹²

A broader source of current data concerning children in the West Virginia is needed for policy makers, funding agencies, professional educational organizations, and oral health professionals to allocate funds, determine the needed size of a dental work force, and target areas of specific needs. An important aspect of oral health is the prevalence of hypodontia/oligodontia/anodontia. Early recognition and treatment planning for dental care is needed for children with hypodontia/oligodontia/anodontia. To the authors' knowledge, there is no such available data on its prevalence in

this unique culture. The purpose of this study is to determine the prevalence of permanent tooth hypodontia/oligodontia/anodontia in West Virginia children and to compare the prevalence by sex.

Methods

Study design

A cross sectional study design was used for this West Virginia University (WVU) Institutional Review Board approved study (Proposal 1709772065). Data were collected from a total of 500 WVU School of Dentistry digital panoramic radiographs of children, ages 6-12 years, taken from August 2, 2010 to September 15, 2017 and captured in the WVU research electronic data capture (REDCap) system.¹³ The electronic dental chart administrator did not provide a list of electronic dental charts by date of panoramic radiographic imaging, rather by consecutive chart numbers of participants who had a panoramic radiographic code. The list was therefore randomized by date of service and the reviewers divided the list between them. Panoramic radiographs were examined for permanent teeth, or any stage of permanent development from tooth buds onward (excluding third molars), referred to as permanent tooth buds/permanent teeth. Additionally, the presence of retained primary teeth, were recorded. The age range (6-12 years) was appropriate for the visualization of the development of permanent tooth buds/permanent teeth on the panoramic radiographs. When a permanent tooth bud/permanent tooth was not visible on a panoramic radiograph, and a primary tooth was present, researchers identified the condition as a retained primary tooth.

The researchers achieved calibration by viewing 10 panoramic radiographs together and had 100% agreement on the presence or absence of permanent tooth buds/permanent teeth on the radiographs. When a researcher had a question about a panoramic radiograph, he or she consulted the other researcher for agreement. The authors also extracted data reported on the electronic dental record concerning age, sex, race/ethnicity, insurance, medications, and recorded American Society of Anesthesiologist status from the medical record (ASA status).

Measures

The key variable of interest was at least one missing permanent tooth bud/permanent tooth versus no missing permanent tooth bud/permanent tooth on a panoramic radiograph (excluding third molars) (yes, no). The variable considered to be associated with at least one missing permanent tooth bud/permanent tooth was sex (male, female). Other variables considered in this study were race/ethnicity

(white, black, other, missing data), insurance (Medicaid, private, or none), medications (0, 1, 2, more than 2), and ASA status (1, 2 or 3, missing category).

Statistical methodology

The data were analyzed for the prevalence of at least one missing permanent tooth bud/permanent tooth. Frequency analyses were determined for the examined charts on all of the variables of interest. Chi square analyses were conducted for the bivariate associations of sex and at least one missing permanent tooth bud/permanent tooth, as well as with the other variables. Logistic regression analysis models (unadjusted and adjusted) for the association of sex on at least one missing permanent tooth bud/permanent tooth were developed. Tests were also performed to determine the frequency of the missing permanent tooth bud/permanent tooth most likely to have not be present on the panoramic radiograph, and if there were any retained primary teeth. SPSS, version 24 (IBM; Armonk, New York) was used for statistical analyses. An a priori level of significance was set to <0.05.

Results

Variables of interest

A total of 500 panoramic radiographs and dental records were reviewed (n=500). There were 52.2% female panoramic radiographs examined. A majority of the radiographs were of children who were white, had an ASA of 1, were not taking any medications, and had insurance (Table 1). The sample was considered to be reflective of all West Virginia Appalachia children as the West Virginia child population is over 90% white and has access to dental insurance through the Child Health Insurance Program (CHIP), Medicaid, or private insurance.

No child in the sample had anodontia, however, 12.0% (n=60) of the children had at least one missing permanent tooth bud/permanent tooth.

Bivariate analysis on variables versus sex

Table 1. Bivariate analysis of missing permanent tooth buds-permanent teeth in West Virginia Appalachian children ages 6-12 years and variables of interest, n=500

	Total	No Missing Teeth*	At least 1 missing tooth*	p-value
Sex				.027
Male	262 47.8%	239 91.2%	23 8.8%	
Female	238 52.2%	201 84.5%	37 15.5%	
Race				.757
White	294 58.8%	261 88.8%	33 11.2%	
Black	26 5.2%	Cell sizes suppressed	Cell sizes suppressed	
Other	12 2.4%	Cell sizes suppressed	Cell sizes suppressed	
Missing data	168 33.6%	144 85.7%	24 14.3%	
ASA status				.141
1	301 60.2%	268 89.0%	33 11.0%	
2 or 3	169 33.8%	149 88.2%	20 11.8%	
Missing data	30 6.0%	Cell sizes suppressed	Cell sizes suppressed	
Medications				.199
None	286 57.2%	254 88.8%	32 11.2%	
1	100 20%	82 82.0%	18 18.0%	
2 or more	111 22.2%	101 91.0%	10 9.0%	
Missing data	3 0.6%			
Insurance				.666
Yes	329 65.8%	291 88.4%	38 11.6%	
No	171 34.2%	149 87.1%	22 12.9%	

Results from reviewing panoramic radiographs of children ages 6-12 years.

Fisher Exact Chi-Square test P-value presented

¹American Society of Anesthesiology status

* Panoramic radiographs were examined for the absence of permanent teeth, or any stage of permanent development from tooth buds onward (excluding third molars).

Table II. Logistic regression of sex on missing permanent tooth buds-permanent teeth in West Virginia Appalachian children ages 6-12 years and variables of interest, n=500

	Unadjusted Odds Ratio [95% Confidence Interval]	<i>p</i> -value	Adjusted Odds Ratio [95% Confidence Interval]	<i>p</i> -value
Sex				
Male	Reference group		Reference group	
Female	1.91 [1.10, 3.32]	.022	2.11 [1.18, 3.75]	.011

Results from reviewing panoramic radiographs of children ages 6-12 years.

Adjusted model was adjusted with race, American Society of Anesthesiology status, number of medications, and insurance coverage.

* Panoramic radiographs were examined for the absence of permanent teeth, or any stage of permanent development from tooth buds onward (excluding third molars).

Bivariate relationships are also presented in Table I. There was a significant association of female sex and at least one missing permanent tooth bud/permanent tooth as compared with males ($p=0.027$). There were 15.5% of females who had at least one missing permanent tooth bud/permanent tooth as compared to 8.8% of males who had at least one missing permanent tooth bud/permanent tooth. The other variables failed to reach significance.

Logistic regression analyses

In unadjusted logistic regression analyses of sex on at least one missing permanent tooth bud/permanent tooth, females had an odds ratio of 1.91 [95% Confidence Interval: 1.10, 3.32; $p = .022$] as compared with males (Table II). In adjusted logistic regression analyses of sex on at least one missing permanent tooth bud/permanent tooth, females had an adjusted odds ratio of 2.11 [95% Confidence Interval: 1.18, 3.75; $p = .011$] as compared with males. Other variables in the analysis failed to reach significance.

Table III displays the specific missing permanent tooth buds/permanent teeth and specific retained primary teeth. The permanent maxillary left and right lateral incisors had the most missing teeth in the maxilla (14.1%, $n=19$; $n=16$, 11.9%) respectively. The permanent mandibular left second molar had the most missing teeth in the mandible (7.4%, $n=10$). The most common retained primary maxillary tooth was the right second molar (13.8%, $n=8$) and the most common retained primary mandibular tooth was the left second molar (17.2%, $n=10$).

Discussion

Early recognition of hypodontia, oligodontia, and anodontia is important for dental practitioners. Such recognition allows for careful assessments and considerations for available treatment options and patient management.¹⁴ This is particularly important when patients present with retained primary teeth,¹⁶ or have morphological simplifications of their permanent teeth which is commonly associated with hypodontia and oligodontia including reduced mesiodistal crown lengths, lower/absent cusps or cingula, convergent crowns and shorter/conical roots.³ Specifically, there are associations of hypodontia and oligodontia and

permanent maxillary molars having absent or small cusps of Carabelli, and permanent second molars with only three cusps.³

Current research indicates that, if the root and coronal structures of retained primary teeth are functional and aesthetic, or if aesthetic improvement/restoration/increase in vertical dimension is needed and can be accomplished, it is often beneficial to retain primary teeth as bone and soft tissue is maintained in this circumstance.¹⁵ Long-term survival of some primary teeth has been shown to be equivalent to that of implants or other fixed restorations.¹⁵ In one study consisting of 20 participants, radiographs were taken at an identified baseline and followed by radiographs taken at a minimum of 5 years from the baseline (and up to 30 years) a total of 28 retained primary mandibular molars without permanent premolars were identified.¹⁶ At the end of the study, 86% ($n=24$) retained primary molars were maintained (mean retention 12.5 years).¹⁶ If no retained primary teeth are present, treatment options could include orthodontic treatment, implants, crown and bridge, or partial dental prostheses. In each case, tooth size is important in the treatment planning.¹⁷

In this study of hypodontia, oligodontia, and anodontia in permanent teeth of children in West Virginia Appalachia, the prevalence of hypodontia and oligodontia among children ages 6-12 years was 12% (15.5% females; 8.8% males). No child presented with anodontia. This prevalence of hypodontia and oligodontia is higher than reported values for North America (3.9%) and specifically the U.S. (3.6%-5.1%).¹ Results of this study indicate that West Virginia Appalachia females are more likely to have hypodontia, and oligodontia. Rolling and Poulsen identified a greater female prevalence in hypodontia, oligodontia, and anodontia in combined studies of Danish school children.¹⁸ Brook, et al., indicated females were 1.5 times more likely than males to have hypodontia.¹⁴ Results from this study are consistent with

Table III. Specific missing permanent tooth buds-permanent teeth* or retained primary teeth in West Virginia Appalachian children ages 6-12 years, n=500

Tooth	Number of Missing or Retained Teeth	%	Tooth	Number of Missing or Retained Teeth	%
Number of missing permanent tooth buds-permanent teeth:			Number of missing permanent tooth buds-permanent teeth: (cont.)		
Maxillary right second molar	1	0.7%	Mandibular right first premolar	4	3.0%
Maxillary right second premolar	10	7.4%	Mandibular right second premolar	8	5.9%
Maxillary right first premolar	3	2.2%	Mandibular right first molar	4	3.0%
Maxillary right canine	5	3.7%	Mandibular right second molar	2	1.5%
Maxillary right lateral incisor	16	11.9%	Total	135	100%
Maxillary right central incisor	1	0.7%	Number of retained primary teeth:		
Maxillary left central incisor	1	0.7%	Maxillary right second molar	8	13.8%
Maxillary left lateral incisor	19	14.1%	Maxillary right first molar	1	1.7%
Maxillary left canine	3	2.2%	Maxillary right canine	4	6.9%
Maxillary left first premolar	6	4.4%	Maxillary right lateral incisor	6	10.3%
Maxillary left second premolar	6	4.4%	Maxillary left central incisor	2	3.4%
Maxillary left second molar	1	0.7%	Maxillary left lateral incisor	6	10.3%
Mandibular left second molar	3	2.2%	Maxillary left canine	3	5.2%
Mandibular left first molar	5	3.7%	Maxillary left first molar	3	5.2%
Mandibular left second premolar	10	7.4%	Maxillary left second molar	4	6.9%
Mandibular left first premolar	3	2.2%	Mandibular left second molar	10	17.2%
Mandibular left canine	3	2.2%	Mandibular left lateral incisor	1	1.7%
Mandibular left lateral incisor	5	3.7%	Mandibular left central incisor	1	1.7%
Mandibular left central incisor	4	3.0%	Mandibular right central incisor	1	1.7%
Mandibular right central incisor	5	3.7%	Mandibular right canine	1	1.7%
Mandibular right lateral incisor	4	3.0%	Mandibular right second molar	7	12.1%
Mandibular right canine	3	2.2%	Total	58	100%

Results from reviewing panoramic radiographs of children ages 6-12.

* Panoramic radiographs were examined for the absence of permanent teeth, or any stage of permanent development from tooth buds onward (excluding third molars).

Consolaro et al. in which the authors reported that the most common missing permanent tooth in the U.S. was the maxillary lateral incisor.³

Recent research has been focusing upon genes associated with hypodontia, oligodontia, and anodontia and tooth development in general.^{5,9,14,17} There are four major signaling pathways in the regulation of tooth development: bone morphogenic proteins (BMPs), fibroblast growth factor (FGFs), sonic hedgehog (SHH), and wntless-related integrated site (WNT) ligands and their receptors.¹⁹ The basic genes involved are the homeobox genes, *MSX* (muscle segment family), *DLX* (distal less gene), and the *PAX* (paired box family).¹⁹ Tooth development is altered when the genes are mutated.^{19,20} Epigenetic factors influence genetic expression and may be responsible for higher levels of hypodontia/oligodontia/anodontia in any given population.

Of the many conditions associated with hypodontia/oligodontia/anodontia, perhaps the group of conditions considered the classic example involves ectodermal dysplasias. Ectodermal dysplasias are syndromes in which two or more types of ectodermally-derived organs are affected (teeth, hair, sweat glands, etc.). Of the various types of ectodermal dysplasias, hypohidrotic ectodermal dysplasia is considered to be classic, with symptoms involving hypotrichosis (sparse hair), hypohidrosis (reduced ability to sweat), and hypodontia/oligodontia/anodontia.²¹ The syndrome is inherited as an autosomal dominant, autosomal recessive, or X-linked trait, with the majority of cases being X-linked.²¹ In a study of ectodermal dysplasias by Thesleff, a novel tumor necrosis factor pathway was discovered involving ectodysplasin, the *EDA* pathway.²² The *EDA* regulates ectodermal organ development²² by signaling to its receptor, *EDAR*, to activate the NF-kappa beta pathway to differentiate epithelium into odontoblasts. The diagnosis of classic hypohidrotic ectodermal dysplasia for males is variations in the genes: *EDA*; *EDAR*; *EDARADD*; or *WNT10A*.²² The diagnosis of classic hypohidrotic ectodermal dysplasia for females is variations in the genes: *EDAR*; *EDARADD*; or *WNT10A*.²²

Much of the current research of tooth morphogenesis involves learning about the specific genes, signaling pathways, and epigenetic factors. These studies, conducted primarily on mice with various genes associated with tooth development blocked out, are extremely important in understanding the biological details of tooth development. Additional research is also needed to address physiological, psychological, socioeconomic, and ecological factors that influence the oral health quality-of-life of individuals with missing teeth including treatment options. The current study provides information concerning the higher prevalence of hypodontia/

oligodontia/anodontia in West Virginia children and serves as a baseline needs assessment.

Limitations and Strengths

This study has limitations and strengths. American Dental Association experts created guidelines for radiographs in which panoramic radiographs are recommended to evaluate and monitor dentofacial growth and development, to assess dental and skeletal relationships, and to evaluate craniofacial trauma, based upon clinical judgment.²³ Panoramic radiographs reviewed for this study were noted to have been specifically taken to evaluate dentofacial growth and development or assess dental and skeletal relationships. As such, it is possible that the study sample may have had more missing permanent tooth buds/permanent teeth as compared with a general population. There is also the potential bias toward a higher percentage of hypodontia/oligodontia/anodontia due to the populations using a university dental facility. Dentists within the state may be referring children with complex cases to the university pediatric department for care and the population in the university system may be somewhat skewed. However, the sample of panoramic radiographs included over 60% of children who were ASA 1, and were not taking any medications indicating that the referrals were more likely to be due to the complexity of behavioral issues rather than complex dental procedures.

A strength was the availability of current panoramic radiographs which provided the researchers with a snapshot of current trends. The sample size was also large, providing adequate representation of the area and the investigators had calibrated to 100% agreement on the presence or absence of permanent teeth or the presence of permanent tooth buds on the radiographs.

Conclusion

In this sample of West Virginia children, females were more likely to have at least one missing tooth bud/permanent tooth than males. Early recognition and treatment planning for dental care is needed for children with hypodontia/oligodontia/anodontia. West Virginia children have a high prevalence of missing permanent tooth buds/permanent teeth as compared with children in the rest of the nation.

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Data were collected and managed using REDCap electronic data capture tools hosted at West Virginia University.¹⁴

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