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Transforming inter-professional dental care: assessment of non-dental healthcare workers' knowledge and attitudes towards children's oral health

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BOSTON UNIVERSITY
HENRY M. GOLDMAN SCHOOL OF DENTAL MEDICINE

DISSERTATION

**TRANSFORMING INTER-PROFESSIONAL DENTAL CARE:
ASSESSMENT OF NON-DENTAL HEALTHCARE WORKERS' KNOWLEDGE AND
ATTITUDES TOWARDS CHILDREN'S ORAL HEALTH**

by

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ABSTRACT

Introduction:

Children's Oral Health (OH) is a vital part of their general health. Since many OH problems begin during early childhood, prevention of these problems can be achieved through early and routine preventive dental care. The dental community alone cannot adequately address all oral health care needs. The establishment of an interprofessional oral health primary care workforce team can help provide holistic health care services that can improve children's OH, particularly among under-served populations.

Objective:

The aim of our study was to assess the effect of Interprofessional Education (IPE) on the level of OH knowledge among pediatricians, nurses, speech-language pathologists, nutritionists, and social workers.

Materials and Methods:

Questionnaires assessing participants' oral-health knowledge were collected from pediatricians, nurses, speech-language pathologists, nutritionists and social workers who

are working or studying in Boston, Massachusetts. Pre-test questionnaires were used to evaluate baseline oral-health knowledge and attitude towards IPE. Post-test survey immediately after the IPE training and a follow-up survey after 6-12 months were used to evaluate immediate and long-term retention of knowledge. Pre-, post- and follow-up scores were assigned based on the participants' responses. Univariate parametric analysis methods such as T-test and non-parametric tests such as Kruskal-Wallis and Wilcoxon rank-sum tests were used to assess retention of knowledge and attitude towards IPE. Fisher's Exact test was used to evaluate differences in the number of high scores. Multiple linear regression models were used to adjust for potential confounders. Statistical significance was reported when p-value ≤ 0.05 .

Results:

Among the 557 participants, the immediate post-test scores showed significant improvement when compared to the baseline knowledge scores across different professions ($p \leq 0.01$). The long-term follow-up scores was lower than the immediate post-test scores (statistical significance was not detected across all professions), however, still significantly higher when compared to the pre-test scores ($p \leq 0.01$). Among all the participants, the attitude towards collaboration was high (100%).

Conclusion:

Our results highlight the need for collaboration between dental and non-dental healthcare workforce by incorporating IPE into existing curriculum to enhance the retention of knowledge and increase collaboration after graduation. Continuing education programs can significantly contribute towards long-term retention of knowledge.

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LIST OF ABBREVIATIONS

AAP.....	American Academy of Pediatrics
AAPD.....	American Academy of Pediatric Dentistry
ASBN.....	Accelerated Bachelor of Nursing
ASHA.....	American Speech-Language-Hearing Association
BMI.....	Body Mass Index
CE.....	Continuing Education
EPSDT.....	Early and Periodic Screening, Diagnosis, and Treatment
ECC.....	Early Childhood Caries
FDI.....	Federal Dental International
HRSA.....	Health Resources and Services Administration
HHS.....	Department of Health and Human Services
IPE.....	Inter-Professional Education
IPC.....	Inter-Professional Collaboration
IRB.....	Institutional Review Board
IQ.....	Intelligence Quotient
KAB.....	Knowledge, Attitude and Behavior
MS.....	Mutans streptococci
NPs.....	Nurse Practitioners
OH.....	Oral Health
OHRQoL.....	Oral Health-Related Quality of Life
RNs.....	Registered Nurses

RDNs.....	Registered Dietitian Nutritionists
RIPLS.....	Readiness for Interprofessional Learning Scale
SLPs.....	Speech-Language Pathologists
SWs.....	Social Workers
UK.....	United Kingdom
US.....	United States
WHO.....	World Health Organization
WIC.....	Woman, Infant, Children

INTRODUCTION

Oral Health Disparities

In 2016, the Federal Dental International (**FDI**) Dental World Federation described oral health (**OH**) as being able to talk, taste, smile, touch, eat, swallow, and show facial expressions with self-confidence and no pain, discomfort, or disease of the craniofacial complex.(1) Children's OH is a vital part of their general health and affects their functional, psychological, and social dimensions. There is multiple OH problems such as dental caries, malocclusion, and fluorosis that begin during early childhood. Prevention of these problems can be achieved through early and regular preventive dental care and counselling.(2) Dental caries is one of the most prevalent public health problems among children,(3) it is five times more common than asthma, and seven times more common than fever.(4) In 2015-2016, 21.4% of children aged 2 to 5 years in the United States (**US**) have dental caries in their primary teeth and 8.8% have untreated dental caries.(5)

In Massachusetts, a significant number of young children suffer from dental caries, and many of them start school with dental disease.(6) More than 25% of kindergarten children – approximately 19,130 students –, more than 40% of 3rd graders – approximately 29,110 students and approximately one-third of 6th-grade adolescents – approximately 24,575 students –had evidence of dental decay.(6) Early Childhood Caries (**ECC**) is observed when a child younger than six years of age has one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in a primary tooth.(7) It is a virulent form of dental caries that causes involvement of the pulp in the affected teeth of infants and toddlers.(8)

Dental caries can start as changes in the color of the surface structure to white or brown spots.(9) Visual inspection has been proven to be of high accuracy in detecting carious lesions in the coronal parts of primary and permanent teeth.(10) Dental caries does not only cause damage to the teeth but is also associated with several comorbid conditions.(3) For example, there is an increased risk of future caries, hospitalizations, emergency room visits, and missed school days.(11) Caries can be debilitating and in rare cases can lead to death, as seen with the death of 12-year-old Deamonte Driver in Maryland in 2007.(12) More than five million school days are missed annually due to oral-health related problems.(13) One study showed that children with poor oral health are three times more likely to miss school days than their counterparts, and school performance is proven to be positively associated with oral health status.(14) The risk of ECC and the need for expensive restorative procedures declines later in life when preventive measures are initiated during the first years of life. Family barriers related to getting needed dental care include but are not limited to treatment cost, language and cultural barriers, transportation challenges, and difficulty finding work and childcare arrangements.(15)

Children living in rural areas experience obstacles in receiving oral health care more than same-aged children but from urban areas. This is likely due to the fact that there are not as many dentists serving rural areas where many underserved populations reside.(16) Furthermore, dentists are not geographically distributed evenly enough to provide opportunities to children in rural areas.(17) Furthermore, many general dentists are not comfortable treating young children younger than 6 years of age.(18) Hence, the dental

community alone cannot adequately cover all oral health primary prevention needs.(19) Among the other barriers to dental care, cost was the top barrier even for adults with private dental insurance.(20) The proportion of offices willing to treat Medicaid-enrolled children diminishes as the child's age decreases.(21) In 2014, only 17% of toddler aged 12-23 months, who enrolled in Medicaid had a preventive dental visit.(22, 23) Therefore, the establishment of an interprofessional oral health primary care workforce team is an integral component of increasing access to oral health care for the most vulnerable populations.(19) For example, physicians and nurses have 7-11 times the opportunity to provide oral screening than dentists as a result of the infants' and toddlers' well-child visits especially for those at high-risk,(24, 25) and particularly those from families living in rural areas and or living in a low socioeconomic household.

In Massachusetts, approximately 41.5% of kindergarten, 60.8% of 3rd-grade children, and 48.4% of 6th-grade adolescents from low-income families have been affected by dental caries, which is 1.7 to 1.9 times higher prevalence rate than their more affluent counterparts.(6) Previous research suggests that healthcare professionals including pediatricians and other medical providers as well as community organizations such as nursing homes, hospitals, and school mentoring must be involved as stakeholders to achieve this goal.(26)

Inter-Professional Education

Inter-Professional Education (**IPE**) is an experience that involves instructors and learners from two or more different health professions with different foundational disciplines who conjointly create and foster a collaborative learning environment. The

primary goal of these efforts is to establish knowledge, skills, and attitudes that result in interprofessional team behaviors and competence. Inter-Professional Collaboration (**IPC**) practice has been defined as a process that includes interprofessional communication and decision-making practice between different health care professionals, which enables the separate and shared knowledge and skills of care providers to synergistically influence the patient's management.(27) IPE and IPC are becoming an essential component in the training of healthcare professionals and has become a required component of accreditation standards in some programs.(28)

The World Health Organization (**WHO**) has advocated for the introduction of IPE which aids future healthcare professionals to be prepared for a collaborative role in the healthcare system.(29) IPE allows students from different health professions to learn with, from and about each other's profession and has been recognized as a means to promote and develop the collaboration skills students require in their later profession.(29) Moreover, research studies have shown that students have a higher level of motivation in providing services when supported with an adequate level of education.(30) IPE has been applied in many countries, including the United Kingdom (**UK**) and the US.(31, 32) Many health professionals have received IPE in their professional education; medical practitioners,(33) dentists,(34) nurses,(35) and social workers(36) are some examples. Recent studies(37, 38) shined the light on the importance of early implementation of interprofessional practice and education as it has been shown to improve patient outcomes as a result of coordinated and collaborative practice,(39, 40) it also prevents an adverse reaction between drugs prescribed by different healthcare providers(41). Multiple

barriers to IPE implementation have been reported in the literature including conflicts related to the program length and size, different institutional support, geographical separation, faculty expertise, scheduling conflicts, and varied learning priorities.(37, 38, 42, 43) Students' attitude towards IPE implementation plays a big role in its future success. Inconsistency in students' attitudes towards IPE may be the biggest barrier to its successful implementation.(38, 42–44) However, previous studies also showed that IPE is generally favorable to students if offered to address the problem of blurred IPC roles.(29)

Pediatricians and Pediatric Dentistry

Primary health care is the first reachable and affordable contact, it is also continuous comprehensive, and coordinated to meet the individual and the family's health care needs.(45) Pediatric primary health care covers the child's health supervision and anticipatory guidance; monitoring of somatic and mental growth and development; age-appropriate screening, diagnosis and treatment of different acute, chronic and life-threatening illnesses; it also includes referral of more complex conditions; and provision of coordinated management of health problems requiring multiple disciplinary care.(45) Pediatricians are known to routinely examine infants several times during the first two years of life,(46) and are more likely to see them in their early life than dental practitioners. As previously reported, only 1.5% of infants and children aged 1 year had dental visits compared to 89%-90% who had medical visits annually.(25, 47) This highlights the unique position that the pediatricians have in providing childcare. Pediatricians have many opportunities to assess risks for dental problems and counsel

parents and their children about the prevention of oral-related problems.(48, 49) The role of pediatricians in children's OH was formalized in a policy issued by the American Academy of Pediatrics (**AAP**) in 2003 which was reinforced by another policy in 2008.(50) In the policy document on "Oral health risk assessment and establishment of the dental home", the American Academy of Pediatric Dentistry (**AAPD**) states that pediatricians and pediatric healthcare professionals should acquire the basic knowledge to perform an oral health risk assessment on patients beginning at 6 months of age. Besides, medical professionals should be directed to emphasize the importance of the establishment of a dental home for these patients through referrals to dental practitioners before the children complete one year of age.(51) However, the evidence highlights that oral health awareness levels of qualified medical practitioners including pediatricians may not be satisfactory concerning knowledge about ECC, general oral health, oral hygiene practice, and specialty treatment rendered by pediatric dentist.(26)

Nurses and Pediatric Dentistry

Registered nurses (**RNs**) not only provide and direct patient care, but they also educate patients and the public about various health situations. Nurses represent the largest group in the health workforce in the US.(52, 53) In fact, there are 4 million RNs in the US.(53) About 180,521 RNs provide pediatric patient care to newborn, neonatal, pediatric, and adolescent in a hospital setting.(54) They frequently work with young children and their families, therefore like the pediatricians, the Nurse Practitioners (**NPs**) also are in a unique position to positively influence the oral health and overall health of this population by providing routine oral screening, counseling, and appropriate referrals

when needed.(19, 52, 55) It has been reported that 40% of hospitalized pediatric patients need oral health care, which is either a consequence of the medical condition or a source of complications to the current medical issues.(28) However, minimal attention is given to dental care compared to medical care.(28) Therefore, nurses can play an essential role in these cases by acting as a bridge between patients, families, physicians, and dentists.(28) This puts them in an excellent position to have the required knowledge and skill in the primary healthcare pediatric population.(52) Nurses can start coaching pregnant women during prepartum visits about nutrition, including formula, milk, breast milk, and juice, that play an important role in the development of ECC in primary teeth(19). They can reinforce the impact of falling asleep with breast milk, a bottle of formula, sweetened drinks, sweetened pacifier, or walking around all day with a bottle or “Sippy” cup filled sweetened drinks on the development of tooth decay in the primary teeth.(19) However, various studies reported gaps in the knowledge of nurses about early childhood oral health care,(56–58) which is due to the poor focus on oral health issues.(59) There is limited information in the literature that evaluated oral-health knowledge among nurses.(52) Starting from their undergraduate or graduate education or through clinical professional development programs, pediatric nursing programs can integrate oral health competencies as a standard component of their scope of practice.(19)

Speech-Language Pathologists and Pediatric Dentistry

Speech-Language Pathologists (SLPs) play an important role in preventing, evaluating, diagnosing, and treating speech, language, social communication, cognitive-communication, and swallowing maladies in children and adults.(60) According to the

American Speech-Language-Hearing Association (**ASHA**), the prevalence of communication disorder is approximately 17% of the American population, and about 7% of children suffer from specific language impairment.(61) Early identification of speech disorders is vital since they may progress to lifelong communicative impairments if left untreated.(62) Most speech pathology problems are in fact not recognized until school age despite the connection between early diagnosis and the quality of lifelong communication ability of the child.(62) To aid in the early documentation of children's speech issues, SLPs need to simultaneously work with physicians, occupational therapists, and early childhood educators.(63) Over the past decade, attention to oral health has been growing amongst SLPs, who regularly examine the motor and sensory function of the oral cavity of adult patients during their speech and swallowing evaluations.(64)

Children and adolescents with oral habit presented more orofacial dysfunction and higher impacts on oral health-related quality of life (**OHRQoL**) than the habit-free children and adolescent.(65) This connection suggests a larger role for the connection between speech-language pathologists and pediatric dentists in the detection of early speech pathology.(62) Pediatric dentists are trained in how the oral structures of a child develop.(62) They are aware of how they can affect these structures.(62) For instance, speech production can be affected by the early extraction of primary incisors.(66, 67) Moreover, oral health is an important part of the general health of those with oral or craniofacial problems.(68) Orofacial dysfunctions include the presence of oral habits,(69) which are the main functional factors that encourage the development of

malocclusion.(65) Sucking habits or nail-biting, mouth breathing, and alterations of swallowing are the most common.(70) A tongue-thrusting habit seemed to affect some of the soft-tissue and dental characteristics causing certain problems such as lip incompetency, mouth-breathing habit, hyper-active mentalis muscle activity, lisping, open-bite, and proclination of maxillary incisors.(71)

Several conditions act as common ground for working between pediatric dentist and SLPs. For example, ankyloglossia which is a common congenital anomaly that is manifested by lingual frenal attachment at or near the tip of the tongue.(72) If left untreated, it can be associated with restrict tongue mobility, feeding limitations and speech difficulties among children.(73–76) One study found that parents of children, diagnosed with tongue tie, reported improved speech production and tongue mobility after frenectomy.(77, 78) There are also various craniofacial anomalies that could affect the development of the oral structures and can lead to speech and language issues. For instance, craniosynostosis syndromes includes Apert syndrome which have serious deviations in oral structures, significant hearing loss and low intelligence quotient (**IQ**), which are all factors known to have adverse effects on speech and language development.(79) Cleft lip and palate is another good multidisciplinary opportunity that includes but not limited to pediatric dentists and SLPs. Majority of cleft lip/ palate preschoolers demonstrate delays in speech and sound development and have typical cleft palate phonation.(80) Individuals with cleft lip and palate have errors in speech production due to the abnormalities in oronasal structure/ function, orofacial structure and growth.(81)

Although SLPs are not in a position to directly provide oral care, they are in a position to recognize oral conditions and bring them to the attention of other healthcare providers.(82) For SLPs, the motivation regarding good oral health stems originates primarily from the understanding that the presence of pathogenic bacteria in oropharyngeal secretions is linked to the risk of aspiration pneumonia, especially in patients with dysphagia.(83) However, the literature shows very little interaction between SLPs and pediatric dentists.(62)

Nutritionists and Pediatric Dentistry

There is a bidirectional relationship between oral health and diet and nutrition. Diet and nutrition can affect the oral health; and the oral health can affect the nutrients consumed.(84) The combination of inadequate consumption of nutrient-dense foods and a lower health literacy in addition to limited access to oral health care can put low-income populations at an increased risk for caries and other oral diseases.(85) In 2003, Surgeon General Richard Carmona released A National Call to Action to improve oral health disparities in America.(86) It identifies five action strategies, one of which is focused on increasing collaborative practices, including diet counseling and health education for pregnant women and new mothers. In the 2011, a report from the Institute of Medicine's consensus, Improving Access to Oral Health Care for Vulnerable and Underserved Populations, was addressing the need to provide oral disease prevention education including the role of diet and nutrition in oral disease as a recommendation for improving the nation's oral health.(87)

Dental caries is a multifactorial disease that is caused by pathologic and protective factors.(85) Plaque biofilm, reductions in salivary flow, and cariogenic dietary factors are pathologic factors that can be controlled to reduce the prevalence of dental caries.(85) Registered Dietitian Nutritionists (**RDNs**) can also contribute in reducing risk for dental caries by recognizing changes in salivary flow, cariogenic food and beverage choices, and eating behaviors. The RDNs role in assisting families to adopt appropriate healthful practices comes from the fact that ECC has a predominant feeding and dietary component and that ECC's behavioral determinants are highly cariogenic diets and risky feeding practices combined with insufficient exposures to fluorides.(88) In 2003–2010, Americans aged 6 years and older, consumed about 14% of total daily calories from added sugars,(89) much higher than the recommendation to keep added sugars intake to less than 10% of the total daily calories as part of a healthy diet.(90) Some researchers believe that both the amount and frequency of sugars were linearly related to dental caries in adults.(91) In addition, the introduction of sugary foods and drinks at an early age is known to lead to the formation of a habit that can persist into maturity.(92) In addition, prolonged exposure of teeth to bottle-feeding,(92–95) and feeding at night.(92, 96–98) have been identified as risk factors of ECC. A wider spectrum of information about feeding habits and sugar intake would probably clarify the factors promoting ECC.(95) Failure of early implementation of proper oral health programs may lead to higher rates of future dental caries.(99)

It is also important for RDNs to understand the protective factors used to reduce the caries risk for an individual. Protective factors are related to saliva good oral hygiene,

exposure to fluoride (eg, fluoridated water, fluoride varnish, fluoridated toothpaste), consumption of foods containing fluoride and other essential nutrients, and consumption of cariostatic food (eg, cheese, milk, yougrt).(85) In addition to eating habits, Mutans streptococci (**MS**), the main bacteria causing caries, can be transmitted from mothers and other caregivers with high levels of the bacteria to the child.(100–102) The inhibition of vertical transmission of bacteria, establishing good feeding habits, and hygiene practices can significantly minimize a lifelong battle with dental caries.

Additionally, RDNs need to be aware of oral conditions that compromises the oral-health integrity, RDNs may need to modify dietary plans and food texture to promote better availability of nutrient from ingested diet. General inspection of the head, neck, oral cavity, and cranial nerve function allows RDNs to further understand the individuals risk factors when developing a nutrition diagnosis to tailor dietary counseling.(85)

On the other hand, pediatric dentists are highly trained specialists that mainly deal with surgical treatment of the effects of poor nutrition. They do incorporate dietary counseling to their practice, but such counseling has not been fund effective. While pediatric dentist mostly treats the symptoms of the disease they fail to treat its etiologic basis, which is nutritional. Thus, it is within the RDNs scope of practice to assess health histories, eating habits and patterns, and diet content before assisting clients in setting and reaching their individual goals.(103) Nutritionists, and Women, Infant, Children (**WIC**) program nutritionist in particular usually see children before the dental health professional.(104–108) Thus, nutritionist’s ability to examine and identify dental decay and refer accordingly is a very essential component in preventing ECC.(109) RDNs can

incorporate information about feeding practices into anticipatory guidance given to new mothers to emphasize the importance of adequate consumption of nutrient-rich foods for normal growth and development of the oral soft and hard tissues. Development of the oral musculature may be delayed if food textures are not well introduced, which can also impact the child's ability to socialize.(110). Multiple studies showed the positive relationship between the level of oral health knowledge, self-efficacy and outcome expectancy, and the confidence for educating, providing preventive services, and dental referrals to their clients among nutritionists.(106, 111)

Social Workers and Pediatric Dentistry

Social work (**SWs**) is a profession that is dedicated to the re-establishment and enhancement of human socialization and the reduction of human suffering by promoting positive changes in social conditions. Their role is related to care coordination.(112) Besides offering clinical social work services to families, social workers are uniquely qualified to participate in many aspects of care coordination in the pediatric health care setting.(112) Health inequalities and social disparities are important attentions of the social work profession.(113) Numerous studies have demonstrated that the health of individuals with lower socioeconomic levels is markedly worse.(114) This relationship exists across a broad array of health indicators, which includes dental health.(114) The characteristics of an area in which individuals lived influenced their oral health status and behavior.(114) As expected, children living in more deprived areas and areas without water fluoridation tends to have more caries.(114)

Areas with high levels of dental decay had lower proportions of normal birth weight babies, lower vaccinations, and higher proportions of single-parent style. In these areas, babies tended to be bottle-fed, weaned later, and consume fruit juices more regularly.(114) In one study, investigators claim that examination of the factors associated with the caries process and the application of useful policies and programs at the state or regional level might reduce the caries level among children.(114) For example, according to Early and Periodic Screening, Diagnosis, and Treatment (EPSDT); a federal program, all children in foster care are mandated to seek medical and dental care within thirty days of placement in a foster care home.(115) However, according to a study, only 1% of children in foster care in New York, Los Angeles, and Philadelphia received the full advantage of EPSDT services, including follow-up treatment.(116) In fact, 67% of children in foster care did not receive dental care at all.(117) However, another study conducted in Iowa showed that children in foster care have 1.29 higher odds of getting dental services; this could be an indication that children in foster care require more dental care than the general population.(118) This highlights another scope of the social workers' practice; child abuse and neglect, which is defined as the failure of the parent or guardian to keep up with treatment necessary to ensure the child's adequate function and freedom from pain and infection despite adequate access to care.(119) Child neglect and abuse have numerous negative consequences on the development of the child. These effects are not limited to disturbing the emotional, psychological, and physiological well-being of a child during childhood, but can also have detrimental lifelong effects in life.(120, 121)

Severe dental caries is one of the first detectable sign of child neglect.(122) These findings put the health care workers involved in the care of children in a unique position to recognize early symptoms of child abuse and neglect.(122) Therefore, anyone who is involved in the care of children should be aware of the association between dental caries and child neglect.(122) SWs, in one study, generally agreed that they have an impact on whether a child in foster care receives the needed dental care or not.(123, 124) Another randomized study found that dietary advice during home visits to new mothers decreased caries prevalence in infants.(125) Thus, with the assistance of social services, the child and their family could receive adequate support and services that are not only limited to dental care.(122) Ideally, SWs are prepared to direct and guide families of children with ECC or at risk for ECC and assist them in adopting and implementing personalized strategies that include goal setting, planning action, and arranging for self-management. During the 20th century, as SWs became increasingly available in the hospital and involved in other health care venues, there were several documented efforts to integrate professional social workers into dental programs, those efforts were pioneered by the Eastman Dental Center (formerly named Rochester Dental Dispensary) in 1917.(113) The literature shows that social workers have been engaged in dental care in multiple universities such as the University of Chicago,(113) University of Maryland,(126) Columbia University, University of New York,(127) University of Washington,(128) and others.(127, 129) There are no enough studies that have examined social workers as a potential intervention point to improve to improve children's oral health.

In summary, the oral health preventive needs of underserved children can only be met

if different healthcare providers worked together to meet one goal which is the patient's overall wellbeing. For that to happen, IPE needs to be implemented early during undergraduate education to produce confident providers who are willing to collaborate with other health professionals in a team-based healthcare system.

Our objectives are to bridge the gaps in knowledge, attitude, and behavior (**KAB**) towards collaboration between different health professions and to improve the future of oral health care services. Specifically, to assess the effect of IPE on the oral-health-related knowledge of pediatricians, nurses, speech-language pathologists, nutritionists, and social workers.

MATERIALS and METHODS

The study is part of a larger effort around the evaluation of inter-professional practice to improve pediatric oral health. This effort was financially supported through a grant from the Health Resources and Services Administration (**HRSA**), one of the units of the Department of Health and Human Services.

The study was approved by the Boston University Institutional Review Board (**IRB**) in 2015. The study involved the delivery of oral health content and evaluation of oral health knowledge and inter-professional attitudes at baseline, immediately after an oral health lecture and after 6 months. Data were collected from multiple professional groups that participated in the inter-professional training; pediatricians, pediatric residents, nursing students, speech-language pathology students, nutrition students, social workers, and social work students who are working or studying in Boston, Massachusetts.

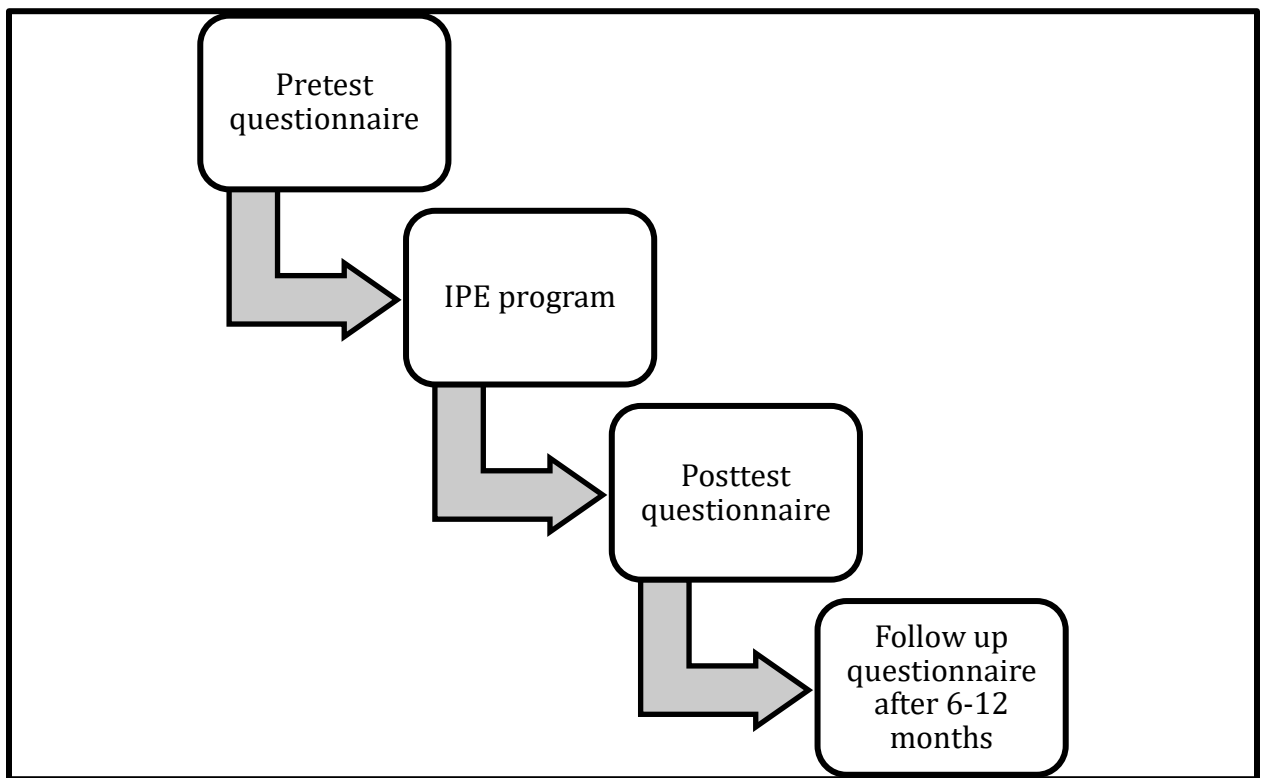
At the beginning of the meeting, participants were asked to voluntarily fill out two separate anonymous questionnaires one of which evaluated their baseline oral-health related knowledge, and the other one evaluated their attitude towards IPE and IPC with other healthcare providers. The beginning of the survey instrument included a full description of the study process. Participants were asked to consent to participate in the study. The questionnaires were delivered to participants either in paper format or electronically through a one-time-use online link that was sent to the participants' email address via RedCap survey tool. After collecting the baseline questionnaires, the participants had a 1-2 hour(s) oral health knowledge lecture. The oral health curriculum covered basic oral anatomy, details on dentition at different stages of development, signs,

symptoms, and clinical presentation of common dental diseases such as dental caries and periodontal disease, etiology, epidemiology, and risk factors of dental caries and methods of preventing dental disease. The lecture was always followed by a period of questions and answers about oral health. While the lectures had a core common curriculum across all professional groups, the presentation and the question-and-answer sessions were specifically tailored to each profession. The lecture(s) was followed by a post-test knowledge questionnaire which was handled in the same two formats used in the pre-test questionnaires; paper-based or online survey tool. After 6-12 months from completing the oral health intervention, a follow-up questionnaire was sent to the participants via RedCap one-time-use online link to the emails provided in the previously filled surveys.

Figure 1 shows a graphic presentation of the study's sequence. The first step involved the comprehensive review of the literature on inter-professional oral care delivery and attitudes about interprofessional practice. The review was followed by the "construction" of the inter-professional pediatric oral health curriculum and its pilot testing. Pilot testing of the curriculum involved initial lectures to pediatric and pediatric dental faculty. Following the creation of the curriculum, questionnaires were developed to evaluate knowledge and attitudes. Pre-test, immediate post-test, and follow up knowledge questionnaires contained identical questions. The knowledge questions were based on literature review and content analysis of the most important aspects of the children's oral health from the points of view of the participating specialties (pediatricians, nurses, speech-language pathologists, nutritionists, and social workers). While there were multiple common questions across the different specialties to allow for comparisons

between specialties, each profession had a specifically tailored knowledge questionnaire to capture unique aspects of interest. The scoring system involved the calculation of points given to each question. A total knowledge score was calculated based on the number of correct answers that a participant scored. A total score was also given to each category separately. The cut-off score to categorize high versus low scorers was set at 60% for all health professionals. Pilot testing and evaluation of the research instrument in the early phases of the study was dynamic and ongoing and led to the implementation of changes that are described below for each specialty.

Figure 1: Sequence of events for the study



Knowledge questionnaires

i) Pediatricians and Nurses

Based on core competencies and scope of work, the same questionnaire was used for pediatricians and nurses. The questionnaire was divided into six categories: Demographics (9 items), general knowledge (5 items), preventable measures knowledge (7 items), dietary knowledge (4 items), oral-systemic connection knowledge (7 items), and confidence in knowledge (4 items). A total score of 45 points was used to calculate the 60% cutoff score (27 points) to categorize high versus low scorers. Specific scores by categories are shown in Appendix A 1.

ii) Speech-Language Pathologists

For SLPs, a preliminary version of the knowledge survey was first used which included three categories only; demographics (3 items), oral-speech/ hearing connection knowledge (7 items), and oral health perception (4 items). Later during the study, the questionnaire was updated to include four more categories besides the original three ones to be a total of seven categories: Demographics (9 items), general knowledge (3 items), preventable measures knowledge (4 items), dietary knowledge (2 items), oral-systemic connection knowledge (3 items), oral-speech/ hearing connection knowledge (7 items) and oral health perception (4 items). A total score of 24 points for the old version and 36 points for the final version were used to calculate the 60% cutoff score (14.4 points for the pilot version and 21.6 points for the final version) to categorize high versus low scorers. Specific scores by categories are shown in Appendix A 1. To be able to

accommodate for the change in the number of questions between the two versions of the questionnaire, the statistical analysis involved a two-stage process; the first level of analysis included all the participants and evaluated only the common questions between the pilot and the final versions of the questionnaire. The second level of analysis included only participants who filled the final version of the survey and comparing all the questions in that version.

iii) Nutritionists

Similar to SLPs, a preliminary version of the knowledge survey was first used which included five categories: Demographics (3 items), general knowledge (1 item), dietary knowledge (5 items), oral-systemic connection knowledge (1 item) and confidence in knowledge (7 items). Later in the study process, the questionnaire was updated to include one new category and more questions were added to the other previously used categories. The final version included six categories: Demographics (9 items), general knowledge (3 items), preventable measures knowledge (4 items), dietary knowledge (8 items), oral-systemic connection knowledge (4 items), and confidence in knowledge (8 items). A total score of 39 points for the old version and 55 points for the final version were used to calculate the 60% cutoff score (23.4 points for the pilot version and 33 points for the final version) to categorize high versus low scorers. Specific scores by categories are shown in Appendix A 1. The statistical analysis to account for differences between the two versions of the survey followed the same methodology as previously described in the SLPs section above.

iv) Social Workers

The questionnaire was divided into six categories: Demographics (9 items), general knowledge (5 items), preventable measures knowledge (4 items), dietary knowledge (2 items), oral-systemic connection knowledge (2 items), confidence in knowledge (4 items) and child abuse/ neglect knowledge (7 items). A total score of 43 points was used to calculate the 60% cutoff score (25.8 points) to categorize high versus low scorers. Specific scores by categories are shown in Appendix A 1.

Attitude questionnaire

Parsell and Bligh(44) developed the Readiness of healthcare students for Interprofessional Learning Scale (**RIPLS**) questionnaire which consists of 19 items. This validated instrument determines readiness for IPE, and explore attitudinal factors that are essential to consider when designing IPE. It uses a 5-point Likert scale ranging from one (strongly disagree) to five (strongly agree) with some reverse-scored items. High scores on the RIPLS represents favorable readiness for interprofessional learning. Thannhauser and colleagues(130) recognized the RIPLS as being among the most commonly used and psychometrically validated scales, and suitable for use in an academic context for measuring attitudes towards IPE.

For the purpose of this study, a modified version of the RIPLS(131) was used to determine the participants' readiness for IPE. Similar to what was done with the knowledge questionnaires, points were given to each question and a total score was calculated based on the individual response. A 60% cutoff score (57 points) was used based on the maximum points a person can collect in the total score (95 points).

Statistical Analysis

Data analysis was conducted using Stata/IC version 16.0. Descriptive analyses were performed to describe the distribution of scores assessing the level of knowledge and attitude, and also to determine the differences between high versus low scorers across participants from all professions. The T-test was used to assess differences between baseline, short-term and long-term levels of knowledge. Pearson Chi-square test was used to evaluate differences in high scoring individuals across different tests and different professions. Non-parametric tests such as the Wilcoxon rank-sum, Kruskal-Wallis Rank, and Fisher's Exact tests were used when evaluating small samples and non-normal data distributions to evaluate differences in the total scores and the number of high scores across different tests and different professions. Multiple linear regression models were used to evaluate differences in the level of attitude among all participants while adjusting for confounders. Statistical significance was reported when $p\text{-value} \leq 0.05$.

RESULTS

Demographic characteristics

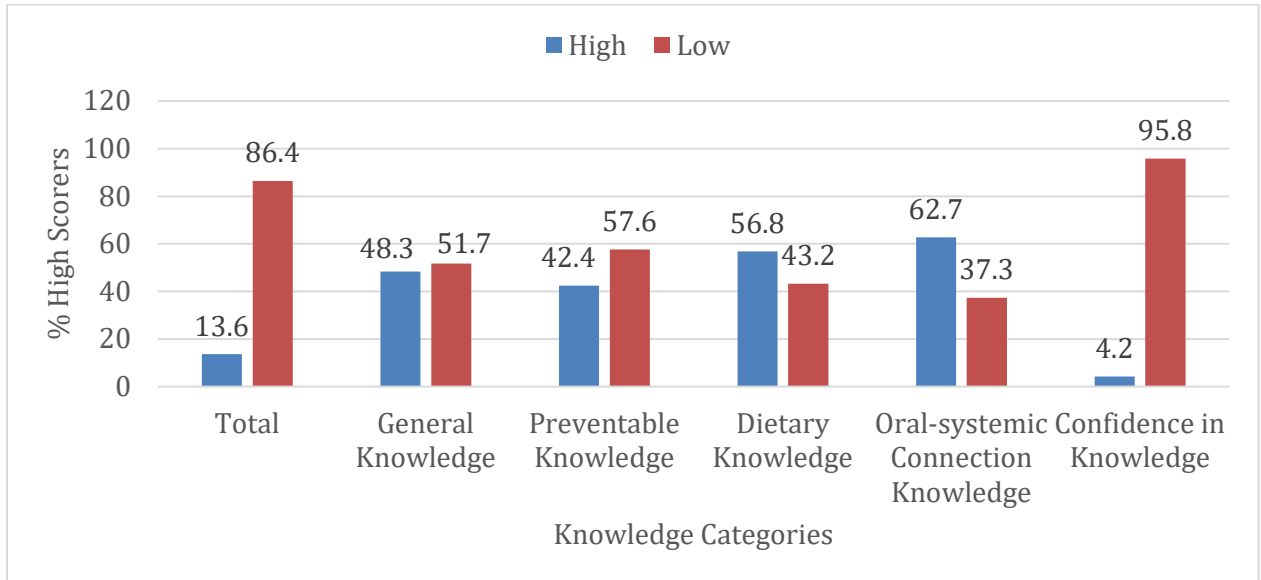
Of 557 participants, demographic information was obtained from 467 (83.84%) including 118 pediatric residents, 204 nursing students, 183 SLP students, 43 nutrition students, and 9 SWs. The age of the participants ranged from 19-60 years with an average age of 23.3 years (Appendix A 2). The majority of participants were female (92.7%), non-Hispanic Whites (71.3%), and students (97.6%).

Evaluating the level of knowledge by profession

i) Pediatricians

The level of oral health-related knowledge at baseline was evaluated among 118 pediatric residents. Overall, the participants on average scored 46.9% (21.1 out of a possible 45 points) (Appendix A 3). The majority scored low with only 13.6% scoring more than 60% of the highest expected total score. When evaluating the level of knowledge by subcategories, the participants scored the highest in understanding the oral-systemic connection (62.7%) and scored the lowest in the level of confidence in their knowledge (4.2%) (Figure 2). Immediate post-test and 6-months follow up surveys were not obtained from pediatricians due to logistical barriers and scheduling conflicts.

Figure 2: High vs Low Scorers (%) among Pediatricians



ii) Nurses

The average score among the 204 nursing students was 22.9% (10.3 points out of a possible 45 points (Appendix A 4). The highest number of high scorers was in the dietary knowledge (27.4%) and the lowest in the level of confidence in knowledge (0%) (Figure 3).

One hundred and seventy-five nurses completed the immediate post-test survey with an average score of 50.9% (22.9 points out of 45 points) (Appendix A 4). The highest number of high scorers being in the oral-systemic connection (90.9%) closely followed by the dietary knowledge category (86.9%) (Figure 3). The number of high scorers slightly increased to 8% in the confidence in knowledge category however it was still the lowest score compared to other categories. When comparing the scores obtained in the

post-test to the baseline scores, a significant improvement in knowledge (+122.3%) was observed in the post-test (p-value <0.01).

Fifty-seven participants (32.6%) completed the long-term follow-up assessment with an average of 44% (19.8 points out of 45 points) (Appendix A 6). When compared to the immediate post-test, a 13.5% decrease in the overall score was observed (p-value = 0.00). However, when compared to the baseline level of knowledge, the follow-up test scores showed a significant improvement (+92.2%) (p-value <0.01) (Appendix A 5). Statistically significant differences were found when comparing the number of high scores between baseline and immediate post-test (p-value <0.01), between baseline and long-term post-test (p-value <0.01) and between immediate and long-term post-tests (p-value = 0.02).

Figure 3: Pre vs Post High Scorers (%) among Nurses

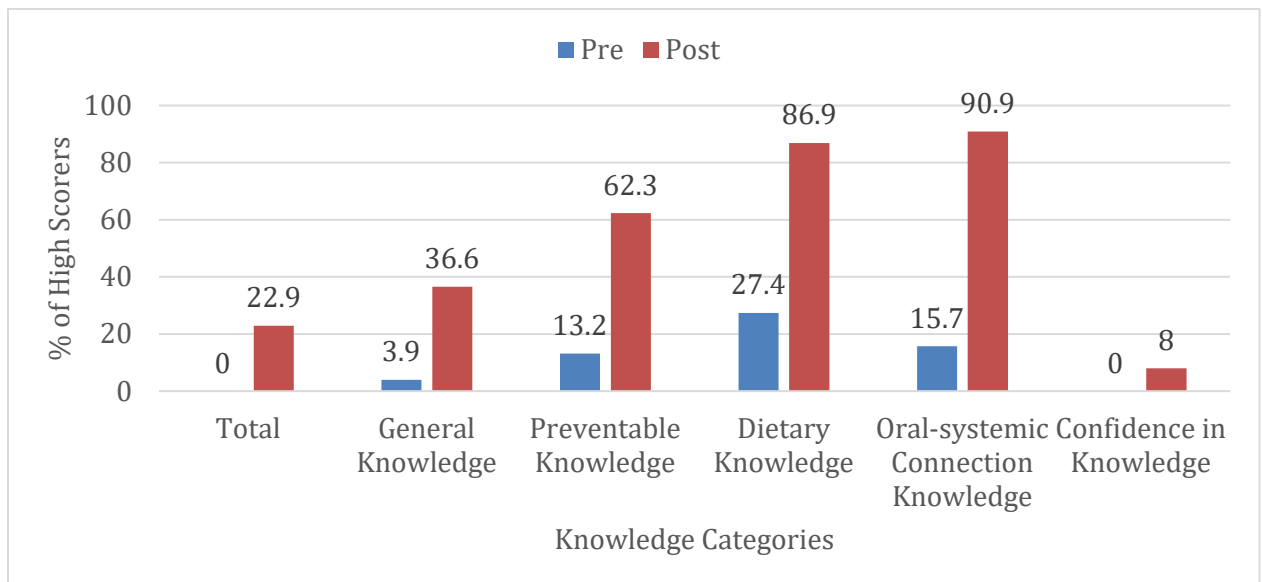


Figure 4: Pre vs Follow up High Scorers (%) among Nurses

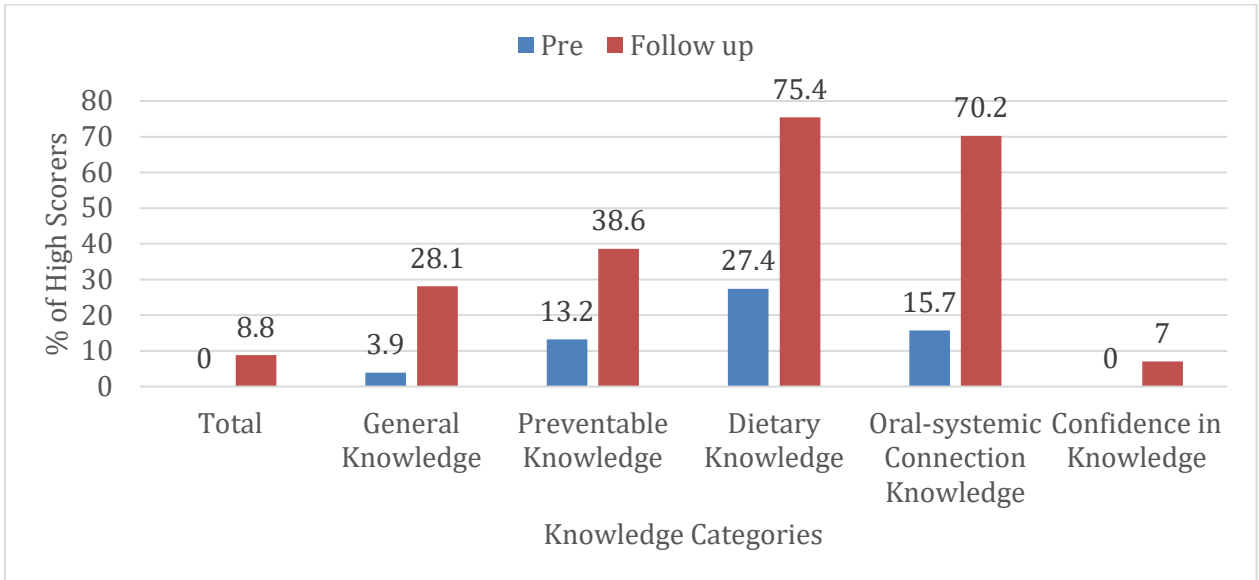
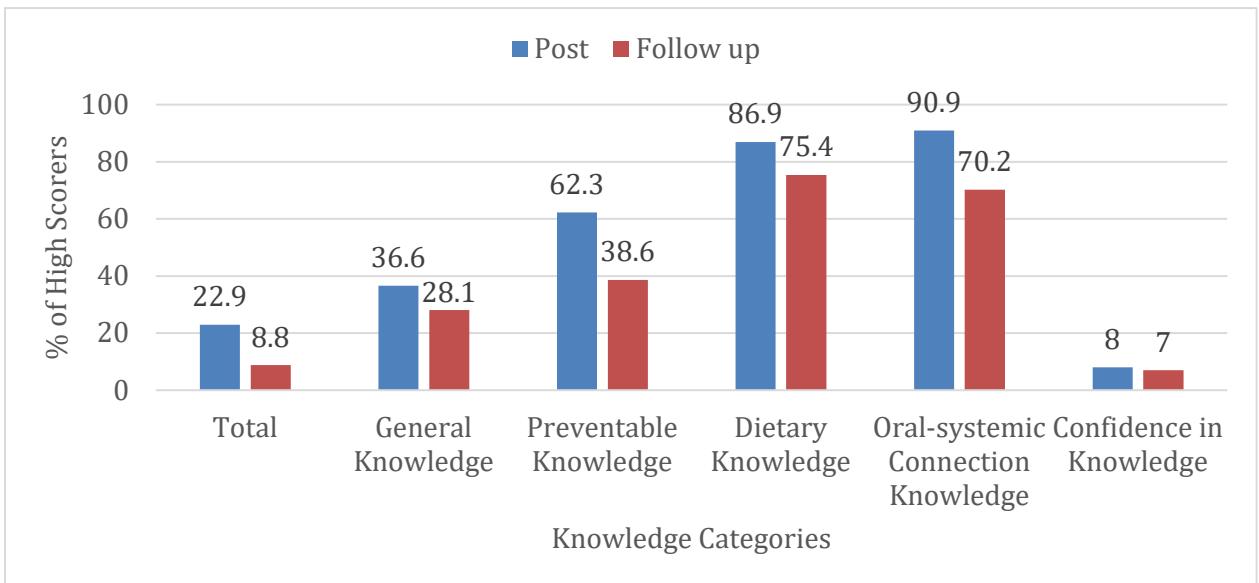


Figure 5: Post vs Follow up High Scorers (%) among Nurses



▪ *Comparison of scores between Pediatricians and Nurses*

Data collected from pediatricians were obtained mostly from pediatric residents who are undergoing specialty training and the data obtained from nurses was mostly from

general nursing students who are not yet specialized to treat pediatric patients. When comparing the scores obtained by the pediatricians and nurses, a statistically significant difference was observed in the total score at baseline (p-value <0.01) with the pediatricians' average score of 46.9% (21.1 out of 45 points) compared to 22.9% (10.3 points out of 45 points) for the nurses. None of the nurses scored more than 60% of the total score. A statistically significant difference was also detected in the number of high-scoring nurses (0%) when compared to high-scoring pediatricians (13.6%) in the level of total knowledge as well as in the subcategories (p-value <0.01).

iii) Speech-Language Pathologists

- *Pilot Questions*

The pilot questions evaluation includes evaluation of participants who answered the common questions that are part of both the pilot and the final versions of the questionnaires.

When evaluating data from 180 participants who completed all of the baseline common questions, an average total score of 75% (18.0 out of 24 points). The three categories that were assessed at baseline, immediate post-test, and 6-12-month follow-up include overall or total knowledge, oral-speech/hearing connection knowledge, and perception towards oral health. The majority of the participants reported high levels of knowledge in all three categories with 85.6% in the total knowledge, 74.4% in the oral-speech/hearing connection knowledge, and 90.6% on oral health perception.

Participants who completed the immediate post-test survey for the common questions (n = 145) scored a total average of 87.5% (21.0 points out of 24 maximum possible points) and more than 95% scored high in all three categories. Among those who responded to the 6 to 12-months follow up common questions (n = 64; response rate = 60.4%) an average of 83.3% (20.0 points out of 24 points) in the total score was reported. Similar to the results observed at baseline and in the immediate post-test, most participants scored high (>90%) in all three categories.

When comparing results from the pre versus the post-test surveys, complete information was available for 145 participants. A significant improvement in knowledge (+18.0%) was observed in the post-test (p-value <0.01) (Appendix A 7). When the scores from the follow-up test are compared to the immediate post-test a slight decrease in the overall score was observed (-4.3%) (Appendix A 9) however when compared to the baseline level of knowledge, the follow-up test scores (+12.4%) still showed a significant improvement (p <0.01) (Appendix A 8). Statistically significant differences were observed when comparing the number of high scores between baseline and immediate post-test (p-value <0.01) and between baseline and long-term post-test (p = 0.01).

Figure 6: Pre vs Post High Scorers (%) among SLPs (Pilot Questions)

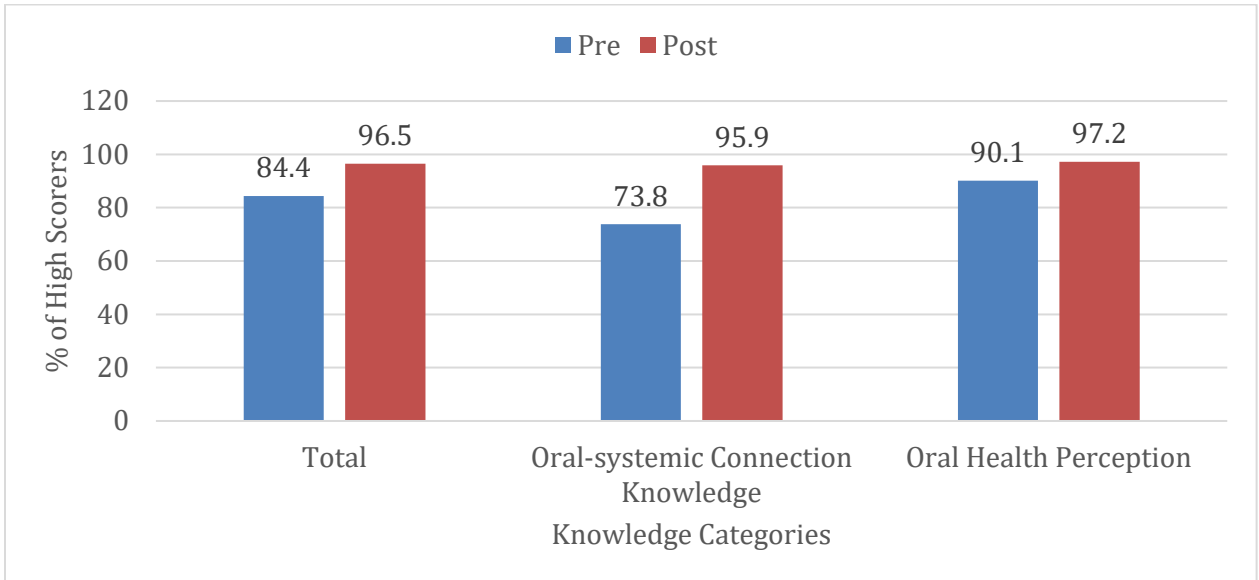


Figure 7: Pre vs Follow up High Scorers (%) among SLPs (Pilot Questions)

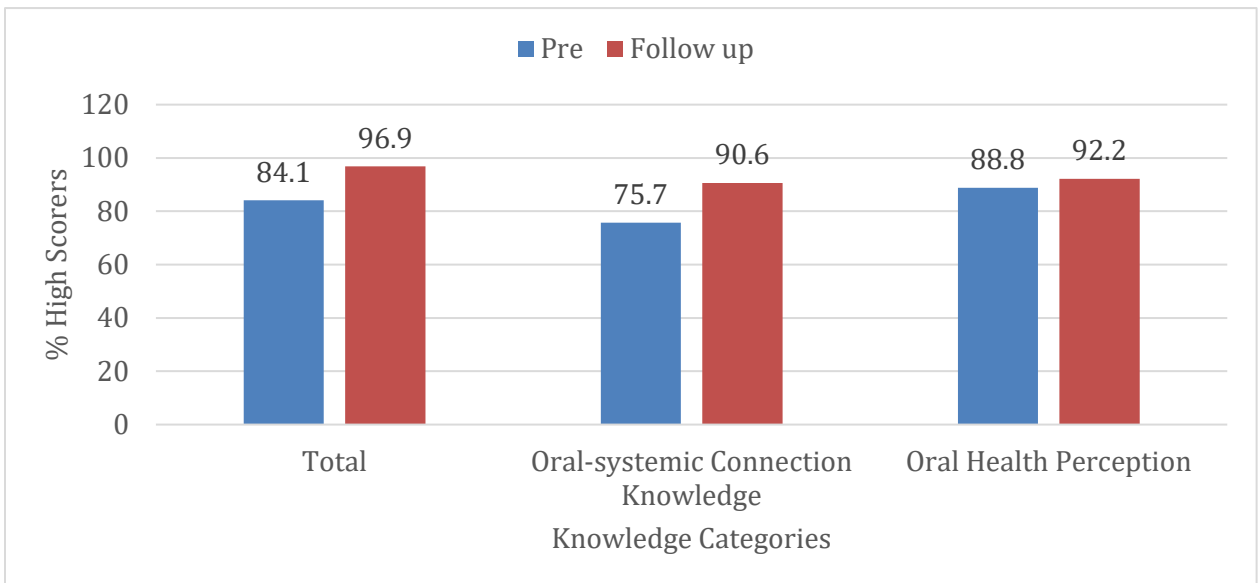
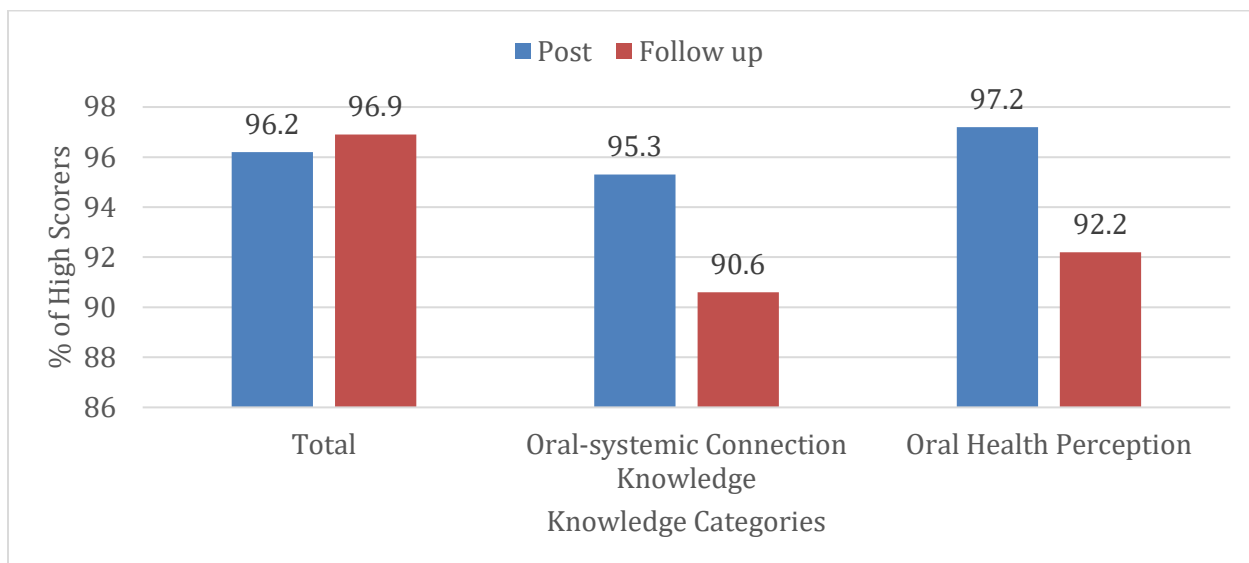


Figure 8: Post vs Follow up High Scorers (%) among SLPs (Pilot Questions)



▪ *Final Questions*

The final questions evaluation includes evaluation of responses from participants who responded to the final version of the questionnaire which includes both the pilot and final set of questions.

A total of 150 participants completed the new version of the baseline questionnaire with an average of 65% (23.4 points out of 36 possible points). The knowledge categories that were evaluated include total, general, preventable, dietary, oral-systemic connection, oral-speech/hearing connection, and also included the level of oral health perception. At baseline, the highest number of participants who scored >60% of the score was in the oral health perception knowledge category (90%) and the lowest number of high scorers was in the knowledge on prevention category (13.3%).

Among 115 participants who completed the new version of the immediate post-test questionnaire, the average score was 83.5% (30.1 out of 36 possible points). In this post-

test, $\geq 95\%$ of the participants scored high in total knowledge, oral-systemic connection, oral/speech hearing connection, and oral health perception categories whereas they scored the lowest again in their knowledge on prevention (61.7%). When comparing the scores at post-test to baseline scores among these 115 participants, an increase in the level of knowledge (+32.6%) was observed at post-test (p-value < 0.01). A significant increase in the number of high scorers was also reported (p-value < 0.01) (Appendix A 10).

At 6-12-month follow-up, 59.2% of participants at the post-test completed the follow-up survey (n = 64) with an average of 79.2% (28.5 points out of 36 points) in total score. Overall, while there was a slight decrease in the overall level of knowledge in the 6-12-month follow-up survey when compared to the immediate post-test (-4.7%) (p = 0.04), there was 7.8% increase in the number of high scorers in the dietary knowledge among participants (Appendix A 12). When compared to baseline the long-term follow-up scores showed a significant increase in the level of knowledge (+27.8%) (p-value < 0.01). A significant increase in the high scorers was also reported (p-value < 0.01) (Appendix A 11).

Figure 9: Pre vs Post High Scorers (%) among SLPs (Final Questions)

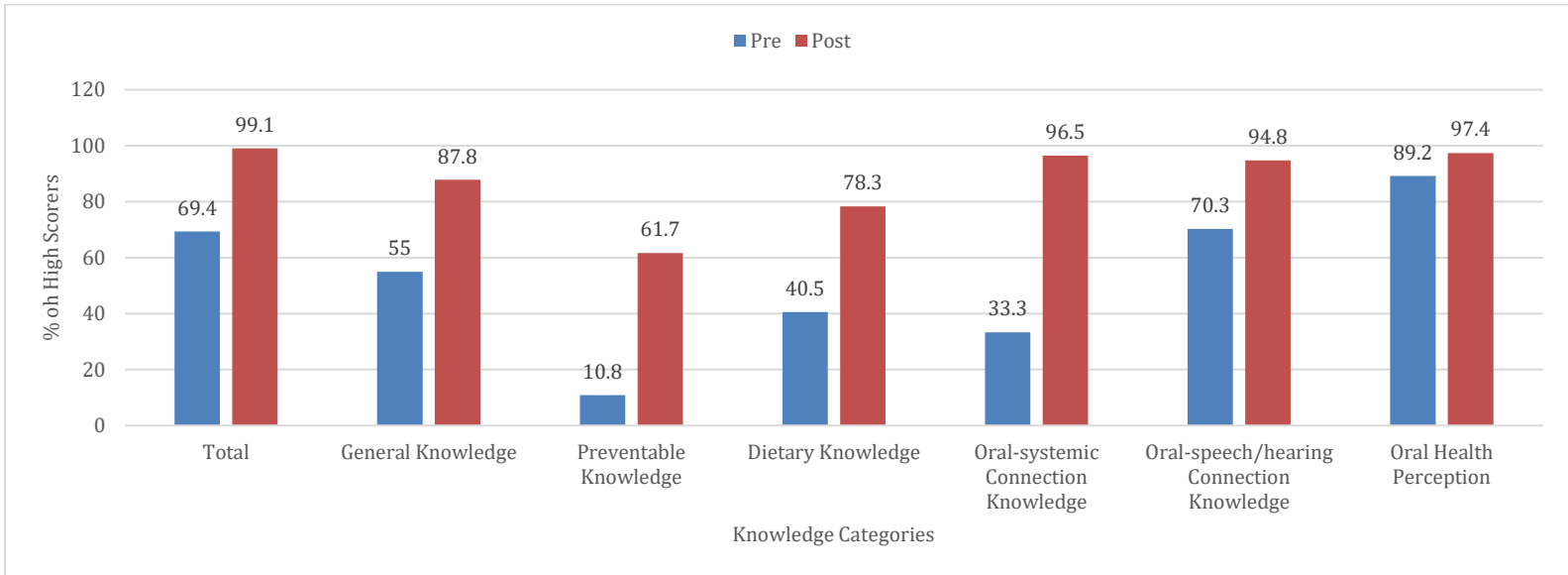


Figure 10: Pre vs Follow up High Scorers (%) among SLPs (Final Questions)

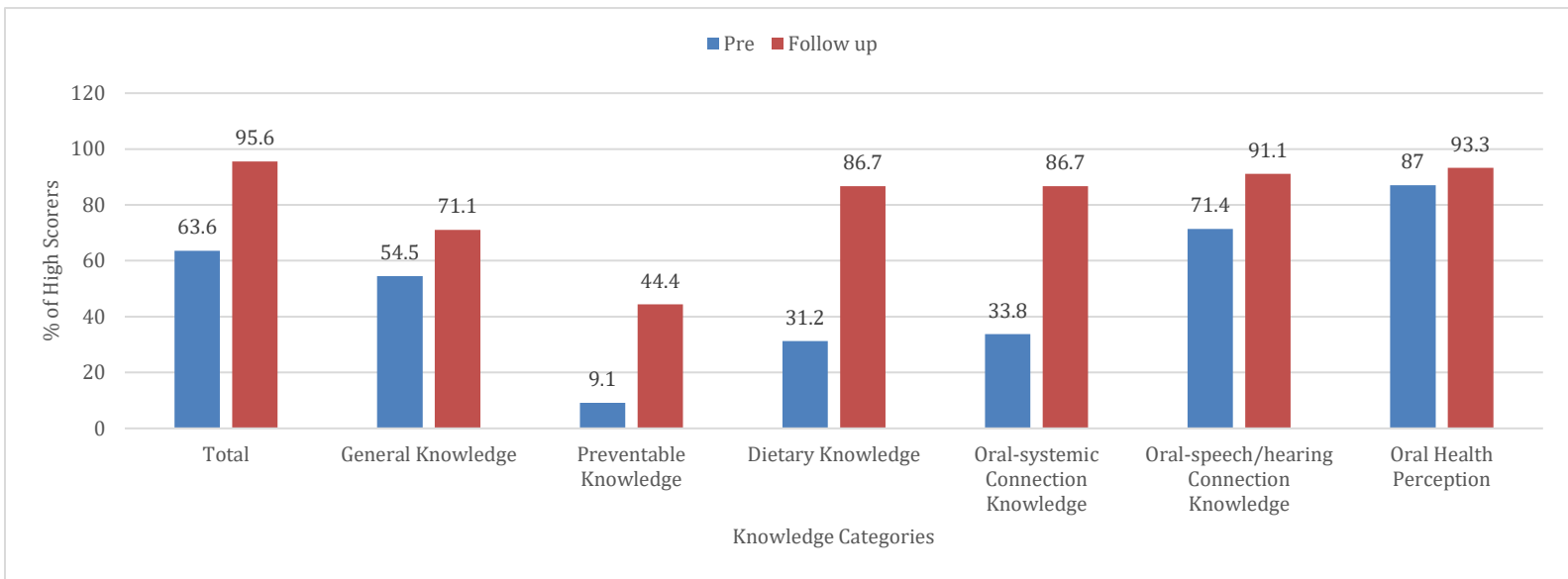
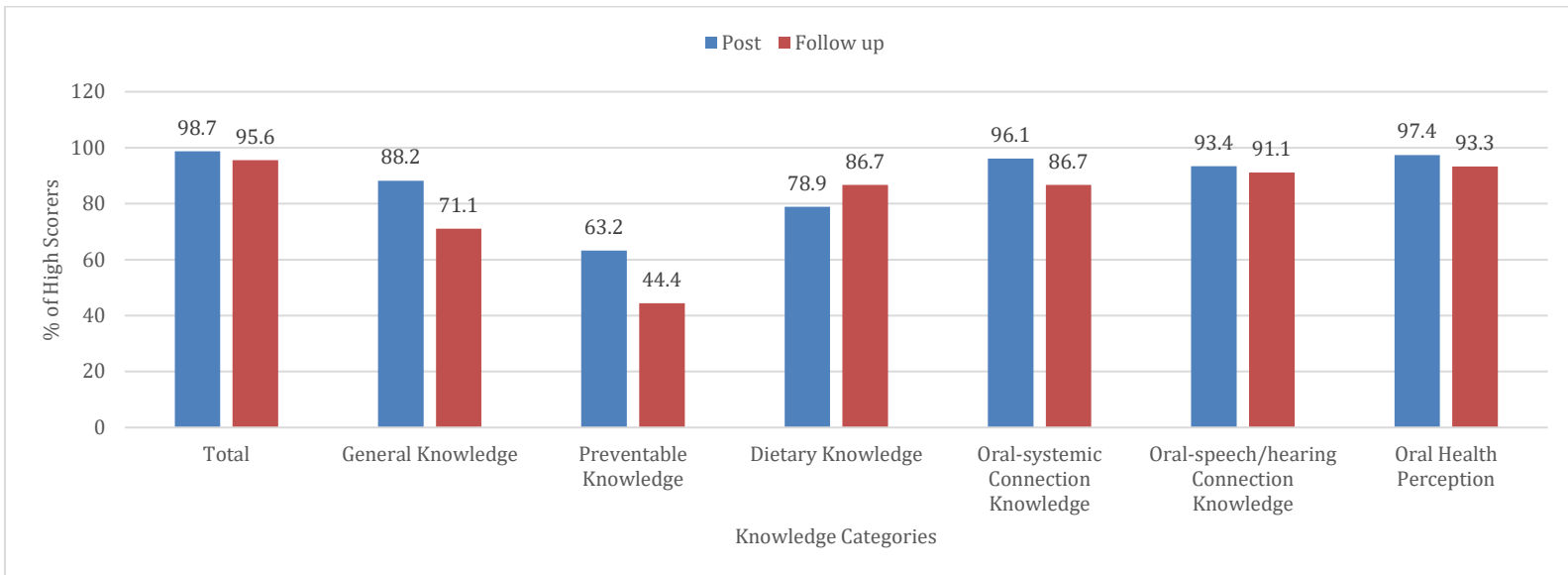


Figure 11: Post vs Follow up High Scorers (%) among SLPs (Final Questions)



iv) Nutritionists

- *Pilot Questions*

Pilot questions evaluation includes evaluation of participants who answered the common questions that are part of both the pilot and the final versions of the questionnaires.

Participants who completed the baseline common questions (n = 43) scored an average of 53.8% (21.0 points out of 39 points) in the total score. The categories that were evaluated include total, general, dietary, oral-systemic connection, and confidence in knowledge. Overall, participants scored the highest (93%) in the oral-systemic connection knowledge whereas they scored the lowest in their confidence in oral health knowledge (11.6%).

All participants who completed the baseline also completed the immediate post-test pilot questions (n = 43) and showed an improvement in the score with an average of 73.6% (28.7 points out of 39 points) in the total score. The majority of participants scored high in most of the sub-categories with the lowest number of high scorers (53.5%) in the general knowledge category. When comparing the immediate post-test to the baseline scores, a statistically significant increase in the level of overall knowledge (+36.7%) was observed (p-value <0.01). Statistically significant improvement in the number of high scorers was observed when comparing the number of high scorers between the pre-test and the immediate post-test (p-value <0.01) however, there is a slight reduction in the number of high scorers in the general knowledge category (Appendix A 13).

At 6 to 12-months follow up only 15 nutritionists completed the survey (response rate = 51.7%). An average of 66.9% (26.1 points out of 39 points) was reported in the total score. The number of high scorers varied in the sub-categories with the highest in oral-systemic connection (100%) followed by dietary knowledge (86.7%), however, the lowest number of high scorers was observed in the confidence in knowledge category (46.7%). While participants show a decrease in the overall level of knowledge at follow-up (-9.1%) when compared to the immediate post-test (Appendix A 15), there was a statistically significant improvement in knowledge at follow-up when comparing the scores obtained at baseline (+34.5%) (p-value = 0.00) (Appendix A 14). Statistically significant improvement in the number of high scorers was observed when comparing the number of high scorers between the pre-test and the follow-up test (p-value = 0.01).

Figure 12: Pre vs Post High Scorers (%) among Nutritionists (Pilot Questions)

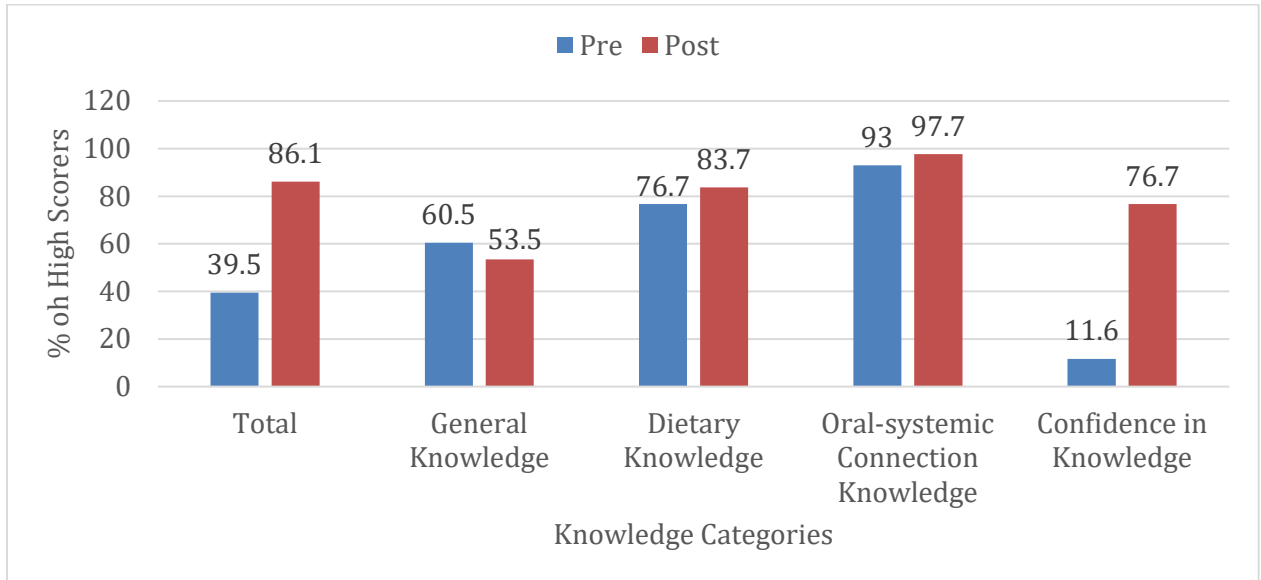


Figure 13: Pre vs Follow up High Scorers (%) among Nutritionists (Pilot Questions)

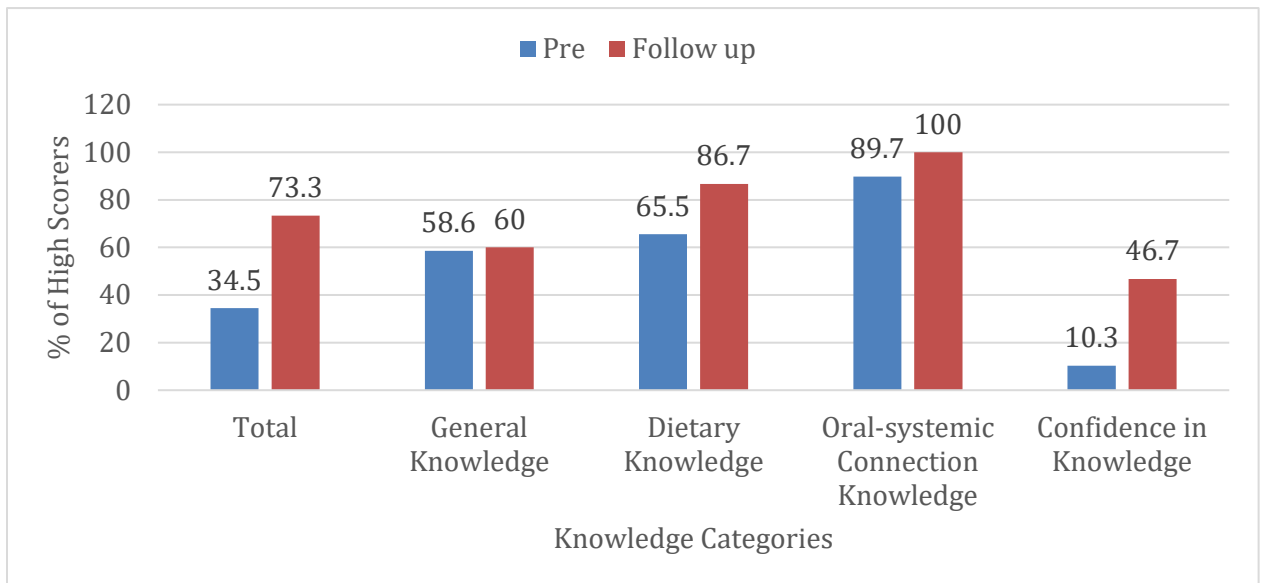
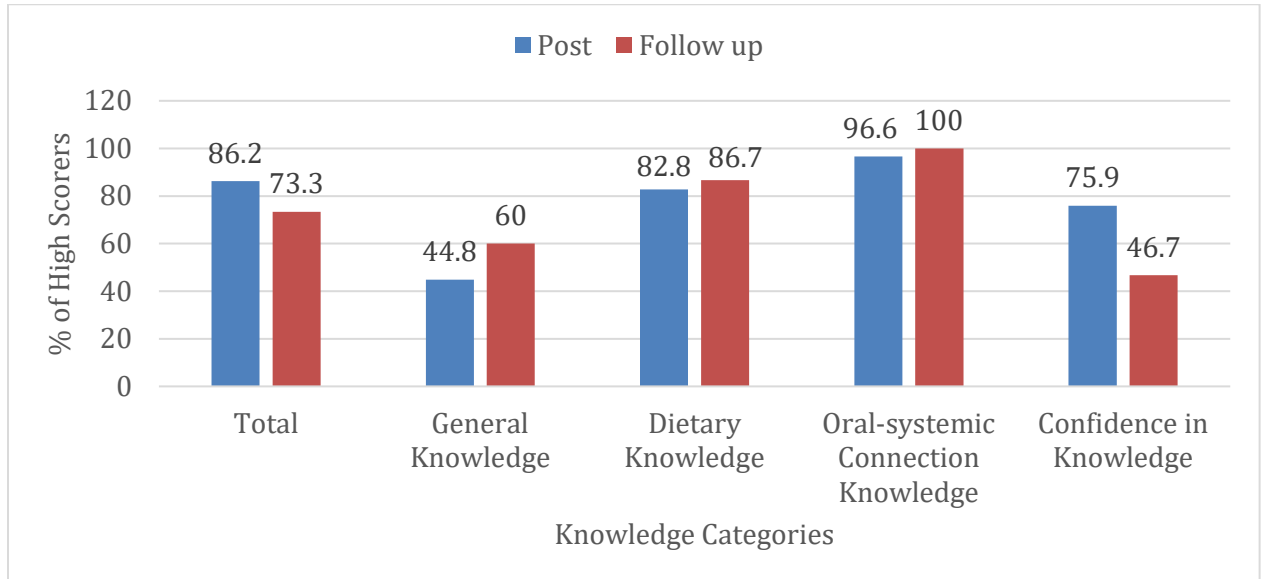


Figure 14: Post vs Follow up High Scorers (%) among Nutritionists (Pilot Questions)



- *Final Questions*

Final Question evaluation includes evaluation of responses from participants who responded to the final version of the questionnaire which includes both the pilot and final set of questions.

Participants who completed the newer version of the baseline questionnaire (n = 29) scored an average of 52.5% (28.9 points out of 55) in the in the total score. As expected, the highest number of high scorers were observed in the dietary knowledge category (69%) followed by the general category (62.1%), and the lowest level of high scorers was observed in the confidence in the knowledge category (17.2%).

All 29 participants who completed the baseline survey also completed the immediate post-test survey. An average of 76.9% (42.3 points out of 55 points) in the total score was reported. In the post-test, there was an increase in the number of high scorers in all

categories with the highest in oral-systemic connection (100%) followed by the total knowledge category (96.5%). The number of high scorers increased to 76% in the confidence in knowledge category. When comparing the scores obtained in the post-test to the baseline scores, a significant improvement in knowledge (+46.4%) was observed in the post-test (p-value <0.01). When comparing the number of high scores between baseline and immediate post-test there is a significant overall increase in the number of high scorers (p-value <0.01) (Appendix A 16).

At the long-term follow-up assessment, among 15 participants (response rate = 57.7%) an average of 70.4% (38.7 points out of a maximum of 55 points) in the total score was reported. As observed in the immediate post-test the highest level of high scorers was observed in the oral-systemic connection knowledge category (100%) and the lowest number of high scorers was in the confidence in knowledge category (60%). When compared to the immediate post-test a drop in the overall score was observed (-8.5%) (Appendix A 18). However, when compared to the baseline level of knowledge, the follow-up test scores showed a significant improvement (+33.9%) (p-value <0.01) (Appendix A 17). When comparing the number of high scores between baseline and long-term post-test there is a significant overall increase in the number of high scorers (p-value = 0.00) and between immediate and long-term post-tests there is a significant reduction in the overall number of high scorers (p-value = 0.04) but still increased in the preventable (80%) and dietary (86.7%) knowledge categories.

Figure 15: Pre vs Post High Scorers (%) among Nutritionists (Final Questions)

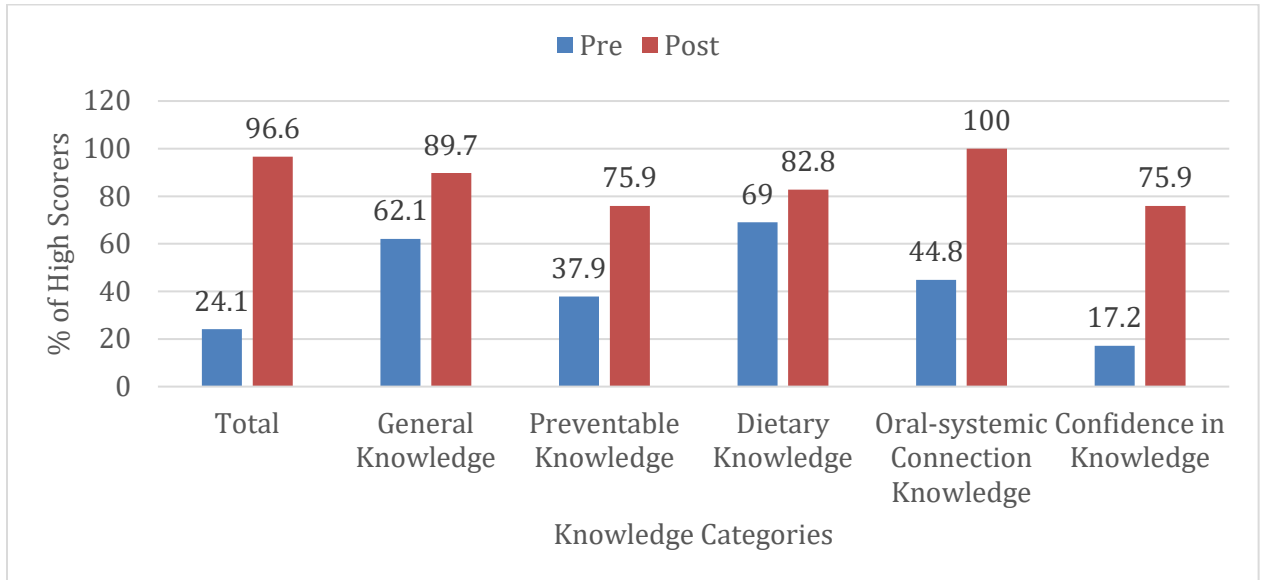


Figure 16: Pre vs Follow up High Scorers (%) among Nutritionists (Final Questions)

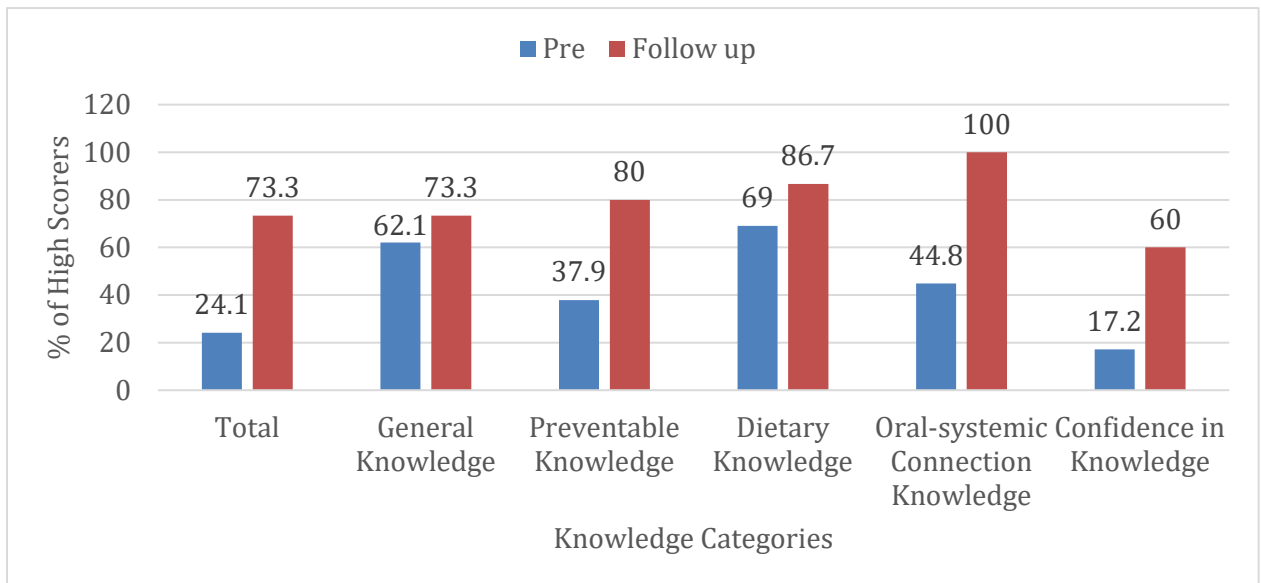
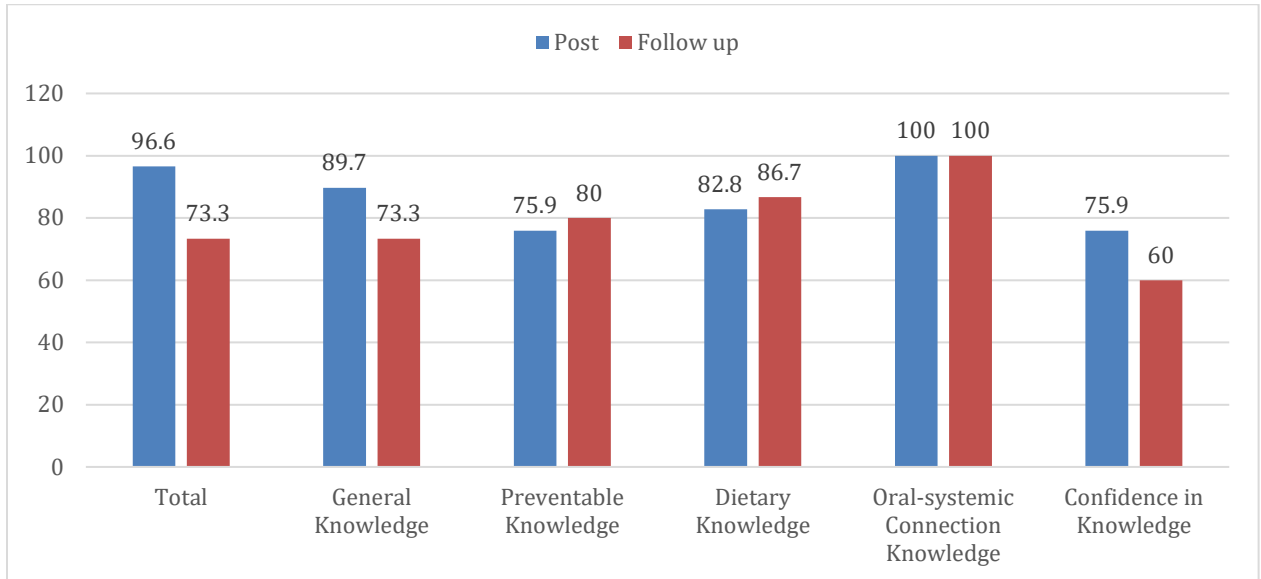


Figure 17: Post vs Follow up High Scorers (%) among Nutritionists (Final Questions)



v) *Social Workers*

A small sample of nine SWs was included at baseline and an average of 57.9% (24.9 points out of a possible 43 points) was obtained in the total score (Appendix A 19). About half (55.6%) of the SWs scored more than 60% in the total score. The SWs scored lowest in the oral-systemic connection knowledge (100% low scorers). The highest number of high scorers was observed in the abuse related knowledge (77.8%).

Immediate post-test and 6-months follow data were obtained from nine and three SWs respectively (response rate = 33.3%). An average of 76.5% (32.9 out of a possible 43 points) was scored in the immediate post-test showing a significant improvement (+ 32.1%) when compared to the baseline score (p-value = 0.00) (Appendix A 19). The average score of the follow-up test was 82.1% (35.3 out of a possible 43 points), a 7.3% improvement when compared to the immediate post-test (Appendix A 21) and 41.8%

improvement when compared to the baseline score (p-value = 0.01) (Appendix A 20) However, the number of participants who scored high dropped to 33.3% and 66.7% in the general and prevention knowledge categories respectively in the follow up when compared to the immediate post-test (Figure 20).

Figure 18: Pre vs Post High Scorers (%) among SWs

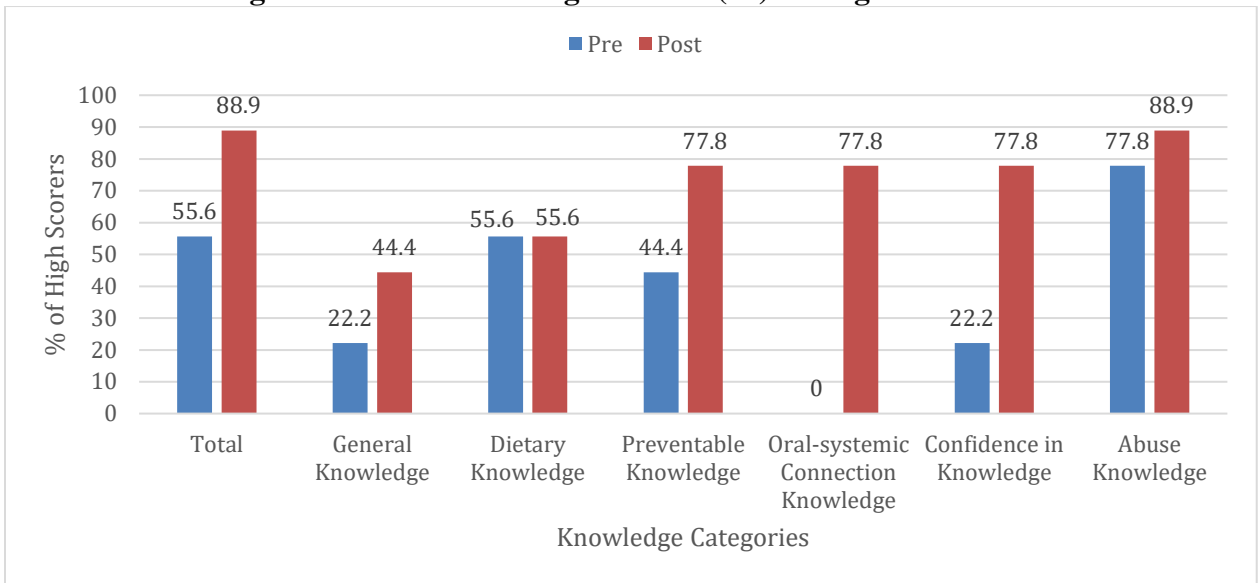


Figure 19: Pre vs Follow up High Scorers (%) among SWs

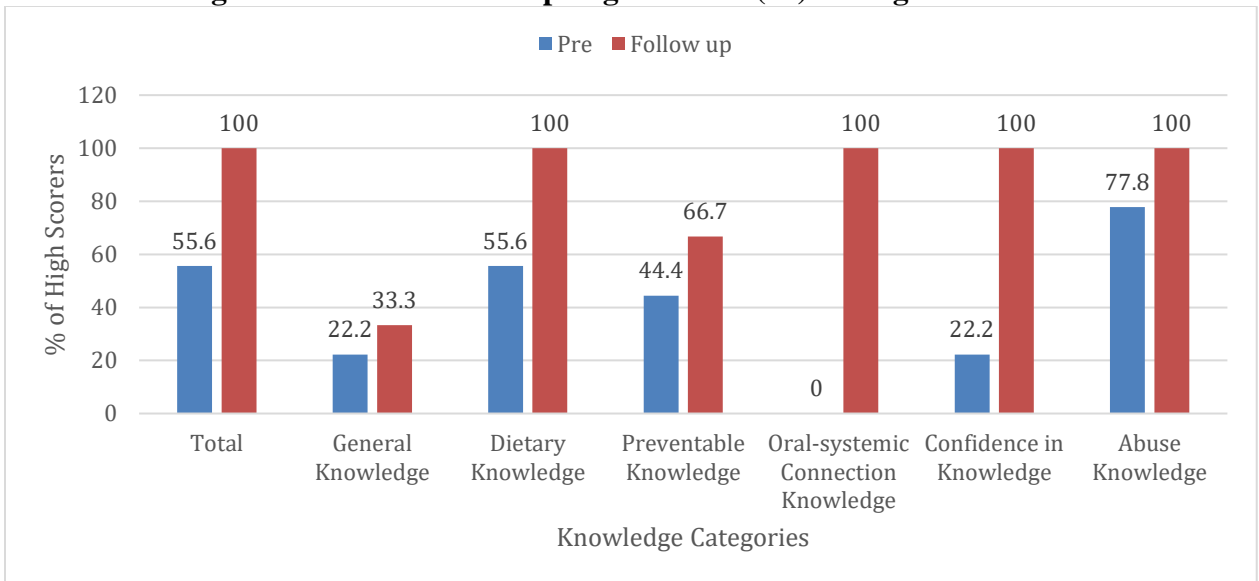
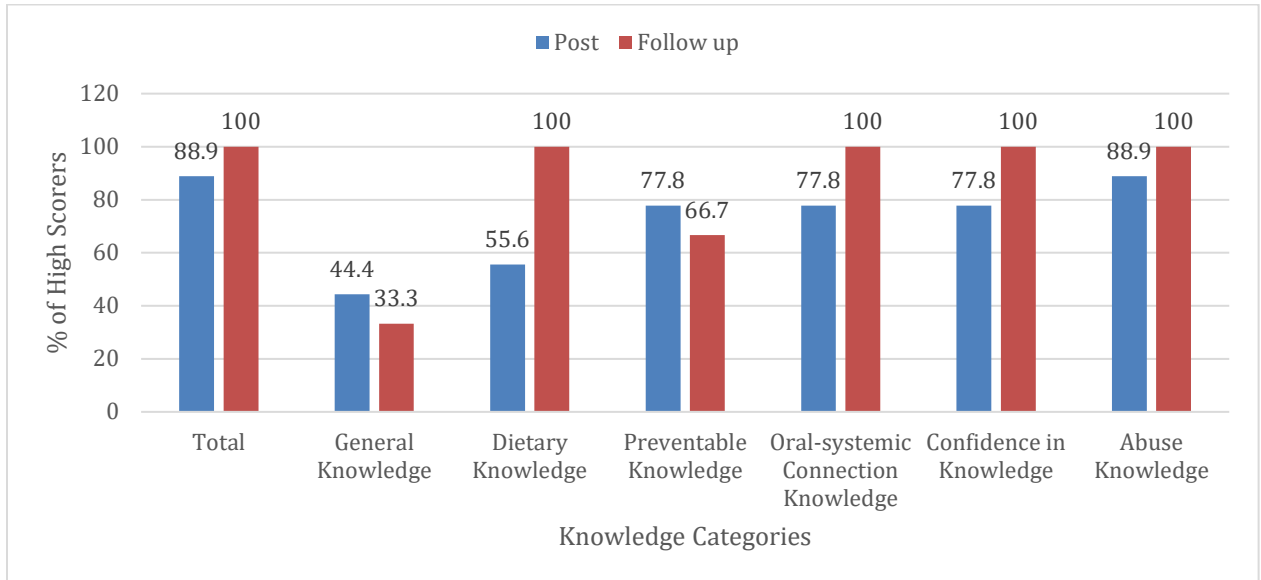


Figure 20: Post vs Follow up High Scorers (%) among SWs

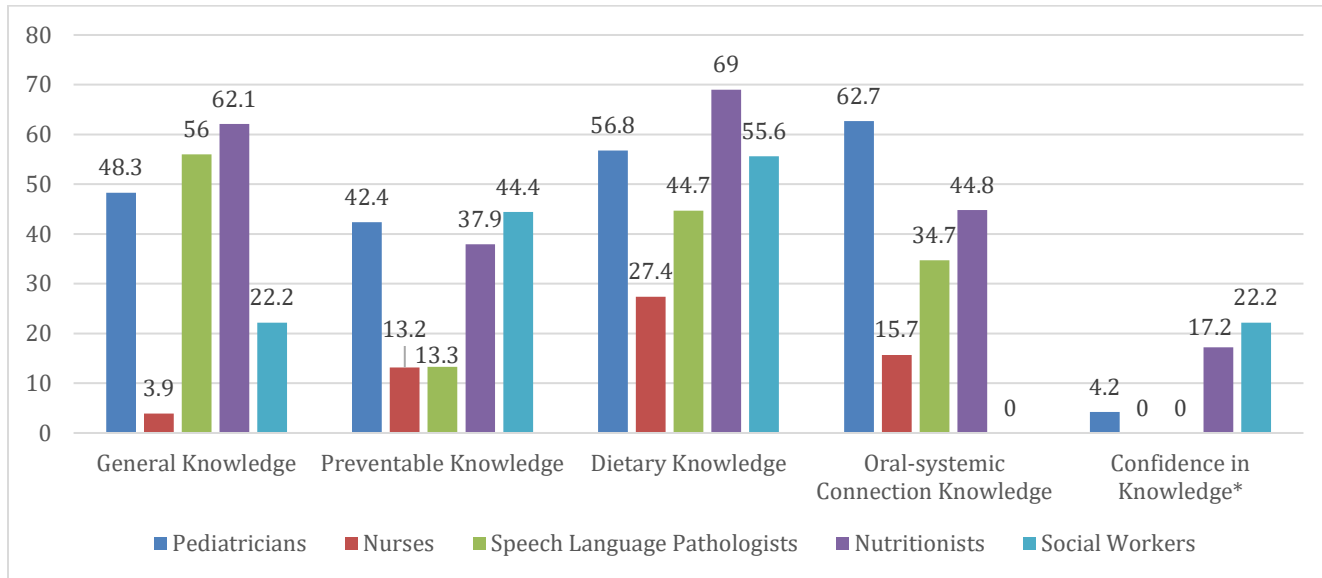


- *Comparing the level of knowledge across all professions*

We compared the commonly shared baseline knowledge categories across all the different professions. Nutritionists had the highest number of high scorers in the general and dietary knowledge categories while SWs had the highest number of high scorers in the prevention and confidence in knowledge categories and pediatricians had the highest number of high scorers in the oral-systemic connection knowledge category (Figure 21). Statistically significant differences were detected when comparing the number of high scorers across all professions (p-value <0.01). In contrast, among the low scorers, nurses scored the lowest numbers in all categories; general, prevention, dietary, oral-systemic connection, and confidence in knowledge categories (Figure 21). When controlling for race, gender did not vary across nurses, SLPs, nutritionists, and SWs, older participants showed a higher level of knowledge than younger participants. However, for

pediatricians, when controlling for gender and race, older participants showed a significantly higher level of knowledge than younger participants (p-value = 0.03).

Figure 21: High Scorers (%) across Professions



*SLPs did not have the confidence in knowledge category

Evaluating the attitude towards IPE and IPC

The attitude questionnaire was completed by 470 participants; 45 pediatricians, 190 nurses, 183 speech-language pathologists, 43 registered dietitian nutritionists, and 9 social workers at baseline. Participants' total scores ranged from 65-95 with an average of 98.6% (85.1 out of a range of 19 to 95). Statistically significant differences were detected when comparing the attitude scores between different professions (p-value <0.01) (Appendix A 22). All participants showed a high attitude towards IPE. Statistically significant differences in the total score were observed when comparing those who had previous IPE experience and those who did not when controlling for age and race. The attitude level in participants who haven't had any previous IPE experience

was 2.2 points less than participants who have had previous IPE experience (Appendix A 23).

Overall, the oral health training that was provided to all the participants improved the knowledge in pediatric oral health. All of the non-dental health care participants demonstrated high long-term retention of oral health knowledge in both post-test and 6-12-month follow-up assessments. There was some attrition in knowledge and confidence at 6-12 months when compared to the immediate post-test scores, however, in comparison to the baseline (pre-training) knowledge, there was a statistically significant improvement in the level of knowledge at follow up. Overall, the attitude among all participants towards IPE and IPC was high and among those with previous IPE training, the attitude was higher.

DISCUSSION

The present study identifies the gaps in oral health knowledge and practices among non-dental health care workers and supports the importance of improving their knowledge through well-designed oral health educational programs for such professionals. This is one of the first studies to include specialists and students from multiple non-dental healthcare professions.

Interprofessional Education

IPE necessitates support, enthusiasm, and participation from faculty members and students from various disciplines. Barriers to IPE can be confronted at various levels of the organization starting from the administration to the faculty members and to the students.(132) At the administrative level, barriers could be due to lack of administrative and faculty support and understanding.(133) At the faculty level, barriers to IPE include lack of IPC training and experience, poor attitude, and poor faculty-to-faculty communication or interprofessional culture.(133) Other barriers could be due to conflict in programs' schedules, and academic calendars, and lack of collaborative partners' availability.(133) In our study, the biggest barriers to IPE were related to scheduling difficulties and the inability to find the time to incorporate oral health educational training into the existing programs.

Questionnaires

The knowledge questionnaires used in our study was tailored to each profession. It included some general categories such as general knowledge, knowledge on prevention of dental caries, dietary knowledge, oral-systemic connection knowledge, and confidence

in participants' level of knowledge. It also included profession-specific categories such as oral-speech/ hearing connection category for SLPs and child abuse/ neglect category for SWs. Questions under each category were obtained from other similar studies in the literature that evaluated the level of oral health knowledge of non-dental health care workers. In addition, some questions and scenarios were created by the investigators in this study to address the most imported aspects of the profession-specific oral health-related topics that had not been previously evaluated in the literature.

The level of attitude towards IPE and IPC was evaluated using a modified version of the RIPLS(131) which is developed by Parsell and Bligh to determine the participants' readiness for IPE.(44) More details on this are provided in the methods section.

i) Pediatricians

This study results demonstrated reluctance in some aspects of the oral health knowledge among the pediatricians which impacted the overall level of knowledge. Only 13.6% of the participants scored high in their overall knowledge. A similar study done in Saudi Arabia revealed that only 1.4% had scored more than 60% in the dental knowledge.(134) Evidence from another recent study reported that the majority of the surveyed pediatricians showed poor knowledge regarding ECC and oral health; only 17% had any knowledge about ECC.(26)

The first dental visit is an essential aspect of the child's well-being. The quality of preventive healthcare needs and future oral health recommendations are determined by that visit. It is recommended that the first dental visits for children take place before age one. (49) This is in agreement with the AAPD and AAP guidelines which state that the

first dental visit should be within 6 months of the eruption of the first set of teeth.(2, 135)

There is a diverse opinion among pediatricians on the ideal age for the establishment of dental home and the importance of the first dental examination after birth.(26) These different opinions could be because many pediatricians are not aware of the AAPD recommendations for pediatric preventive dental care.(26) In the US, a national survey in 2008 reported that only 17% of pediatricians suggested that the first dental visit should be conducted by the first year, while about 50% recommended that the first dental visit can occur at 3 years old for healthy children.(136) In contrast, more than half of the pediatricians in our study (57.5%) agreed to the statement that a child's first dental visit should occur by 2 years of age or when all primary teeth have completed eruption. Only 4.24% were not sure if it is necessary to refer a pediatric patient to a dentist even when an oral health problem is identified. Findings in the literature report a lower level of awareness on the first dental visit. In one study only 28.6% pediatricians recommended that the first dental visit should be between 6 months and 1 year of age.(137) Another study in India reported that pediatricians did not advise first dental visits by the age of 1 year and 43% waited until the child was 3 years old before referring to a dentist.(46) In contrast, a recent study reported that 70.8% of pediatricians agreed that children should be referred to a dentist when caregivers/patients report dental problems, and 70.8% suggested that the first dental visit should be at the first birthday.(26)

In terms of ECC associated behaviors and factors, there was some awareness among the pediatricians in our study about the risk factors. For instance, the majority (91%) agreed that frequent snacking with carbohydrates increases the risk of ECC, whereas in

the level of knowledge was lower in a previous study that showed that more than half of the pediatricians indicated that having meals in close succession increases the risk of caries (62.9%).(11)

MS is the most important bacteria responsible for dental caries.(138) Vertical transmission from the mother to the child is considered the main reservoir for the bacteria.(139) In our study, 67.5% of pediatricians knew that cavity-causing bacteria could be transmitted from the mother whereas in comparison to a previous study reported that only 26.15% of pediatricians were aware of this vertical transmission.(26) Pediatricians are responsible for pediatric medicated syrup prescriptions which are sweetened and taken in the form of syrup(26). The sweetened nature of the medicated syrup can contribute to the development of dental caries when prescribed frequently. In our study, 81.9% of pediatricians acknowledged that frequent use of medications during early childhood is linked to their oral health whereas previous studies have reported a much lower level of knowledge among pediatricians. One study reported that only 32.3% of pediatricians acknowledged the cariogenicity of medicated syrups(26) and similarly another study reported that only 27% of pediatricians acknowledged the significance of the cariogenicity of medicated syrups.(49)

In previous research, while the majority of pediatricians acknowledged their role in the prevention of oral disease, only a few reported being confident about their ability to diagnose dental caries and dental plaque.(137) Moreover, as evidenced in an earlier study that reported that half of the experienced pediatricians (54%) were confident about detecting dental caries, compared to only 36% who had 5–10 years of experience and

31% with less than 5 years of experience.(140) The same study also reported that half of the responders (52%) were confident in consulting with families about their children's oral hygiene.(140) In our study, the levels were lower as only 38% of the participants were confident diagnosing ECC, 31%, felt that they have sufficient knowledge to perform caries risk assessment, 43% felt that they have sufficient knowledge to do oral-health education, and 10% felt that they have sufficient knowledge to prenatal oral health counseling.

The AAP recommends an annual preventive visit for children until the age of 21 years which usually includes but not limited to vaccinations, Body Mass Index (**BMI**) measures, hearing and vision assessment, psychological and behavioral assessment, etc.(141) However, oral preventive measures are not included as part of these well-being visits. The AAPD recommends the use of fluoridated toothpaste (generally 0.1% F; 1000 ppm F) twice a day as a primary form of prevention.(142, 143) A recent study done in the US revealed that 47% of participating pediatricians recommended children brushing their teeth with a toothbrush and toothpaste only after all primary teeth erupted.(144) While a third of another study population agreed with the statement that fluoride toothpaste should not be given to children younger than 3 years old.(140) The majority (91%) of our participants acknowledged that it is recommended to brush baby teeth however only 32% recommended flossing baby teeth. Half of our participants reported that they either will not prescribe systemic fluoride for children younger than 2 years or they are not sure about it even if they live in an area with insufficient water fluoridation. Also, about quarter did not know that ingesting fluoride while the teeth are forming (before the

eruption) helps prevent tooth decay, and only about half of them disagreed to the statement that toothpaste containing fluoride should not be used to brush a 1-year-old child's teeth due to the risk of fluorosis. Only 24% of our participants felt that they have sufficient knowledge to apply fluoride varnish whereas a previous study reported that more than half of the pediatricians (58%) surveyed agreed that they could apply fluoride varnish to prevent ECC in children.(11) A previous study showed that only three-quarters (75.6%) of the participants recommended the use of fluoridated toothpaste to their patients.(137)

For the attitude towards collaboration between pediatricians and dental providers, similar to the finding of our study, previous research studies suggest that pediatric health professionals have a relatively positive attitude towards practicing caries prevention activities if those activities are included in their routine practices.(38) Also, a previous study highlighted the positive attitude towards teamwork, collaboration, and interprofessional education among healthcare professional students who had previously collaborated with colleagues from other departments.(29)

ii) Nurses

Gaps in the early childhood oral health care knowledge of physicians and nurses are clearly highlighted in the literature.(56–58) There is limited exposure of physicians and nurses to the oral health of young patients,(58, 145–147) which is most likely related to the lack of focus on oral health issues education.(59) A study conducted at the University of North Carolina at Chapel Hill to evaluate the oral health knowledge of the first year Accelerated Bachelor of Nursing (ASBN) students, revealed that 77% of respondents

reported having a poor or very poor level oral-health related knowledge in the pre-survey results.(55) Another study conducted in Saudi Arabia found that 16.9% and 56.3% of the participated students had none or little overall perceived knowledge level respectively.(148) A much lower level of knowledge was found in our study where 100% of our participants demonstrated a low level of knowledge in the baseline questionnaire.

Evidence from the literature has shown that participants are able to retain the knowledge gained during their oral health education intervention for five to nine months after completing a training course.(30) For example, a study showed that the overall oral health knowledge was high at pre-test (77.68%), post-test (91.07%), and at 1-month follow up (83.93%).(52) Nurses in another study showed a statistically significant (p-value <0.05) increase in knowledge from baseline to 5-months-delayed-post-survey in questions related to dental caries,(55) there is also a statistically significant (p-value <0.05) increase in self-confidence in providing oral screening and counselling.(55) The present study showed similar findings with a statistically significant increase in the total knowledge levels in the immediate and in the long-term post-tests (p-value <0.01 and p-value <0.01 respectively).

Nursing students' knowledge about the timing of the first dental visit was reported to be low in the US.(30) Overall the evidence from previously conducted studies indicates that less than half of the participants agree that the recommendation for a child's first dental visit is by 6-12 months of age.(148, 149) Our study showed similar findings as well at pre-test (46.3%) with some improvement in the scores at post-test (64.9%) and 6-12 months follow-up (66.7%). In contrast, one earlier study reported higher levels of

awareness on the recommendations for a child's first dental visit where 75%, 100%, and 100% of the participants correctly acknowledged this recommendation in the pre, post, and 1-month follow up tests respectively.(52)

Knowledge about the oral health preventable measures that could be taken during a child-well visit was lacking among nurses in the literature. Both NPs and physicians can safely and effectively provide oral health preventive services to young children in the primary care clinics, with reimbursement provided for these services by Medicaid in many states.(150) However, 61.4% of our participants were not aware of this and 21.3%, in fact, denied it. About 22% and 69% of the participants in two earlier studies agreed to the statement that toothpaste containing fluoride should not be used to brush the teeth of children younger than 3 years due to the risk of fluorosis.(148, 149) In our study, 48.5% of our participants agreed to this and only 44.3% knew that ingesting the right amount of fluoride during tooth formation helps prevent tooth decay. Regarding brushing and flossing baby teeth the misconception was more on advising parents to floss. The level of agreement on the importance of brushing and flossing baby teeth increased by 6% and 12% relatively following IPE training experience.(28) In our study, there is a 17.9% increase in agreement to brush baby teeth and a 21.1% increase in agreement to floss baby teeth. Only 12% of the nurses in one study(148) knew the benefit of xylitol, a sugar substitute that can kill decay-causing bacteria. The level of knowledge about the benefit of xylitol was low at baseline (21.6%) however this increased significantly to 71.8% immediately after the training and 56.1% six months after the IPE training.

Caries risk factors need to be known and well-addressed by nurses during well-child visits. A previous study has shown that caries risk factors were well known by 62.5% of the participants before an IPE activity.(52) However, 59.2% in another study said that it is okay to put infants to bed with a bottle of juice or milk and only 62% in the same study knew the relation between frequent snacking and increased the risk of ECC.(148) Our participants showed a higher level of knowledge with 83.3% not supporting putting infants to bed with a bottle of juice or milk and 68.14% were aware of the relationship between frequent snacking and the increased risk of developing ECC. The knowledge level was higher after the IPE training (>85%) and remained high even after 6 months of finishing the IPE. Regarding the vertical transmission nature of the caries-causing bacteria, half the participants in one study(148) and only about 10% of another study(149) knew the bacteria that cause tooth decay to be transmitted from mother to child. Before the IPE, about 47% of our participants were not aware of this mode of transmission and 26% refuted this fact.

Prior to medical intervention, health care providers such as the nurses need to be aware of the oral-systemic connection. All the nurses in one study were aware of this connection.(149) While the level of knowledge about the connection between medical treatment/intervention and the child's oral health at baseline was low (29%) among our participants, following the training the level increased significantly to 93.6% immediately after the training.

Previous evidence has shown that attending IPE courses with dental professionals would improve the nurses' comfort to provide parental oral health counseling and dietary

recommendations.(150) It would also improve their confidence and ability in performing caries risk assessment, oral examination, identifying dental caries, other oral pathology, and application of fluoride varnish.(52, 150) Experience rotating in a pediatric dental clinic is shown to also improve the knowledge level and confidence among nurses (mean of confidence level = 5.33) than before the experience (mean = 0.39) in diagnosing, providing preventive treatments, and pre-natal and post-natal oral health counseling.(28) Similarly, our study participants showed an increase in their knowledge and level of comfort in diagnosing following the training. In another study, 67.8% and 81.4% of the participants were confident conducting a caries risk assessment and oral examination respectively after continuing education (CE) courses compared to only 30.7% and 52.3% among those who did not attend the CE courses.(150) Only 2.5% of our participants felt confident doing a caries risk assessment before the IPE compared to 48.6% after the IPE. Similar patterns were observed with an increase in the level of confidence in examining children younger than 12 years of age following the IPE training.

Multiple studies that evaluated the nursing students' attitudes towards interprofessional learning using the RIPLS tool have reported a positive attitude among nurses towards readiness for interprofessional learning.(151, 152) Hundred percent of our nurse participants showed a high attitude towards implementing IPE. Our study showed that when controlling for age and race, nurses with previous exposure to IPE are almost four times likely to have higher IPE attitude levels compared to participants who did not have any previous experience.

iii) Speech-Language Pathologists

Limited evidence is available on the level of SLPs' knowledge on oral health, and there is no previous research on the level of knowledge on pediatric oral health. One study that evaluated SLPs' perspectives on oral care for long-term care residents and showed that there was some degree of knowledge regarding the negative effect of poor oral health and the general health consequences.(83) Ninety percent of our SLPs had a good awareness of the oral health of pediatric patients, but only about 35% of our participants had a good level of knowledge about the connection between oral health and general health.

iv) Nutritionists

The Academy of Nutrition Dietetics strongly supports the integration of oral health with nutrition services, education, and research in a synergistic multidirectional a connection between diet, nutrition, and oral health.(84) However, as seen with SLPs there are no enough studies describing the integration of RDNs in dental care that were identified in the literature.(88) The timing of the first dental visit of children in which one of the most important aspects of the child's future well-being was missed by more than half of the participants in one study where they indicated that the child's first visit should occur at 3 years of age.(108) A higher number of participants (60%) in our study agreed that the first visit should be at 6 months of age and no later than 12 months.

ECC preventions are strongly linked to the child's fluoride exposure and hence parent's education during nutritional counseling visits plays a major role in implementing those preventive measures. In fact, in one study although 78% of the participated

nutritionists agreed that fluoride prevents tooth decay when applied topically to the surfaces of teeth,(111) only 33% agreed that fluoridated toothpaste can be used for children younger than 2 years of age.(111) In another study, more than 95% of nutritionists and hygienists in the study agreed that fluoride uptake, while the tooth is forming, makes enamel stronger and more resistant to caries.(108) However, only 30% of nutritionists in that study agreed on the role of fluoride on the remineralization of early lesions.(108) Almost 70% of our nutritionists agreed on the benefit of ingesting the right amount of fluoride before tooth eruption, almost 80% agreed to the importance of brushing baby teeth and only 17% disagreed that fluoridated toothpaste cannot be used for children younger than 1 year of age.

ECC is strongly linked to dietary habits that if not addressed early in life could lead to lifelong problems. Nutrition should start coaching parents early in life and address risky behaviors. Almost 86% of the nutritionist participants in our study agreed that late infancy is an important time for nutritionists to start advocating for healthy nutritional practices and good dietary behavior in children. Similarly, 89% of nutritionists in one study correctly linked nighttime use of bottle containing milk to dental decay(111) whereas, only 32% of nutritionists in another study ranked the frequency of snacking as the most important factor.(108) Our study showed a high level of knowledge (>90%) on avoiding bedtime use of bottled milk or juice and understanding the link between frequent snacking and ECC development.

Thirty-eight percent of our study participants were aware of Xylitol's effect on killing oral bacteria that cause cavities, however, a previous study reported uncertainty among

participants regarding xylitol where only 41% of nutritionists correctly identified xylitol as non-cariogenic.(108)

A previous study showed that all nutritionists in a local WIC program are confident in advising women and caregivers about their own and their children's oral health and discuss the role of sugary snacks and drinks in the caries process.(111) In the same study, while the level of confidence was very high for diagnosing lesions and referring children for dental care, 0% would actually examine a child's teeth for cavities, and 44% would refer women or children to dental care.(111) Our participants had a much lower level of confidence when it comes to oral health; only 4.7% were comfortable detecting visible dental cavities, white spot lesions or enamel defects, and plaque in children as part of a routine new or periodic appointment, and only 38.1% were comfortable identifying and referring children with high caries risk to a local dental home or dentist.

v) *Social Workers*

SWs have the opportunity to be involved in the oral health of patients who are under the care of foster care facilities. However, SWs reported that the high caseload and lack of time were the reasons for oral health being a low priority for both SWs and families.(153) In Washington state, a study evaluated the likelihood of a social worker-driven oral health-focused intervention for children in foster care. The study revealed that oral health educational courses would benefit social workers and help in delivering oral health intervention to foster parents during home visits.(153) Our study concurs with this as our participants showed statistically significant improvement of knowledge after the IPE training by 32.1% in the immediate post-test and by 41.8% after 6 months.

All the participants in our study were not aware of the connection between oral disease and the child's well-being. In contrast to another study where participants were able to identify the connection between dental caries and quality of life including increased numbers of emergency department visits due to systemic infections caused by untreated dental cavities.(153)

Confidence in identifying early decay was low unless the decay was very severe.(153) Our participants also showed a low confidence level (11.11%) in detecting early lesions during new and periodic patient appointments.

Overall when comparing across health care professionals, our study results highlight the importance of interprofessional education and collaboration and the results emphasize that early and continued implementation of IPE can improve the short term and the long-term level of oral health knowledge among the non-dental healthcare providers. It also highlights the connection between IPE and the confidence to provide early prevention plans for children during well-child visits or counseling visits.

One of our study limitations includes a lack of sampling variability, which limited our analyses. Our subject pool was the same for each professional group which results in a lack of comparison between different educational curriculum. Recommendations for successful implementation of IPE training include online courses/webinars to overcome the in-person scheduling difficulties which were one of the biggest barriers to our IPE training. Also, incorporating IPE into a pre-scheduled grand round could be helpful in overcoming the busy schedules of health care professionals. One major strength of our study is the inclusion of multiple professionals. Other strengths include a large sample

size for selected professional groups, the assessment of long-term follow up to evaluate the retention of knowledge. Also, our study evaluated the level of knowledge in multiple groups within the same professional group which gives us the confidence to assess the level of knowledge.

Conclusion

The etiology of dental disease in childhood is multifactorial. While Dentistry has made great progress in understanding risk factors and their interaction, only recently we have started to tackle the complex issue of social determinants of health.

Improving population oral health requires that preventive efforts start at birth and involve not only the child but also the family and the broader community. Addressing disease etiology rather than its effects is essential. Such approach requires a concerted effort of an inter-professional team of healthcare professionals.

Two elements of success for an effective inter-professional team have to do with attitude and knowledge of team members.

The results of this evaluation highlight the success of our educational system in building and encouraging positive attitudes around inter-professional work. The great majority of participants overwhelmingly agree about the value of inter-professionalism and its associated public health effects.

This evaluation also highlights the need for a concerted effort to improve the knowledge base of the inter-professional team during their formative years of training with regards to oral health science. Our work documents the success of a common core oral health curriculum across all health disciplines. While it is feasible to incorporate

such core course into the traditional curricula of the health disciplines, such common core curriculum builds confidence and long-term knowledge retention and encourages close collaboration around common preventive goals.

Based on the success of the current work we propose that efforts should be expanded to engage non-dental healthcare providers in oral health training to improve confidence and to promote the likelihood of their practice of preventive oral health(154). Most importantly, dental and non-dental healthcare providers must work simultaneously to improve the quality of preventive oral health care for all young children(11). Achieving appropriate growth and development, supporting healthy social life, advocating for families in need, identifying and addressing early those anatomical limitations that lead to functional impairments in childhood, along with fluoride recommendations, early referral to pediatric dentists, and dietary counseling across childhood, are some of the examples of common ground between dental and non-dental healthcare providers.

In closing, IPE should be incorporated into the curriculum of all health professions to further enhance the retention of knowledge and increase IPC after graduation. A short, concise common core oral health course together with professional continuing education programs and inter-professional training can significantly contribute towards long term retention of basic oral health knowledge and for the provision of improved pediatric oral healthcare.

APPENDIX

Appendix A 1: Knowledge questionnaires category description

	Knowledge Categories	Number of Items	Maximum Possible Score
Pediatricians and Nurses	Demographic	9	N/A
	General Knowledge	5	5
	Preventable Measures Knowledge	7	7
	Dietary Knowledge	4	4
	Oral-systemic Connection Knowledge	7	7
	Confidence in Knowledge	4	22
	Total Score	36	45
SLPs	Demographic	Pilot: 3 Final: 9	Pilot: N/A Final: N/A
	General Knowledge	Pilot: N/A Final: 3	Pilot: N/A Final: 3

	Preventable Measures Knowledge	Pilot: N/A Final: 4	Pilot: N/A Final: 4
	Dietary Knowledge	Pilot: N/A Final: 2	Pilot: N/A Final: 2
	Oral-systemic Connection Knowledge	Pilot: N/A Final: 3	Pilot: N/A Final: 3
	Oral-speech/ hearing Connection Knowledge	Pilot: 7 Final: 7	Pilot: 17 Final: 17
	Oral Health Perception	Pilot: 4 Final: 4	Pilot: 7 Final: 7
	Total Score	Pilot: 14 Final: 32	Pilot: 24 Final: 36
Nutritionists:	Demographic	Pilot: 3 Final: 9	Pilot: N/A Final: N/A

	General Knowledge	Pilot: 1 Final: 3	Pilot: 1 Final: 3
	Preventable Measures Knowledge	Pilot: N/A Final: 4	Pilot: N/A Final: 4
	Dietary Knowledge	Pilot: 5 Final: 8	Pilot: 12 Final: 15
	Oral-systemic Connection Knowledge	Pilot: 1 Final: 4	Pilot: 1 Final: 4
	Confidence in Knowledge	Pilot: 7 Final: 8	Pilot: 25 Final: 29
	Total Score	Pilot: 17 Final: 36	Pilot: 39 Final: 55
	SWs	Demographic	9
General Knowledge		5	5

	Preventable Measures Knowledge	4	4
	Dietary Knowledge	2	2
	Oral-systemic Connection Knowledge	2	2
	Confidence in Knowledge	4	13
	Child Abuse/ neglect	7	17
	Total Score	33	43

Appendix A 2: Demographic Information across Different Professional Groups

		All professions (n = 467)	Pediatricians (n = 44)	Nurses (n = 190)	SLPS (n = 183)	Nutritionists (n = 43)	SWs (n = 9)
Age (years)	Mean \pm SD	23.3 \pm 4.8	28.9 \pm 2.8	19.6 \pm 2.1	24.3 \pm 2.3	26.1 \pm 4.2	40.0 \pm 13.2
Gender n (%)	Male	34 (7.3)	16 (39.4)	9 (4.7)	5 (3.3)	2 (4.9)	1 (11.1)
	Female	431 (92.7)	28 (63.6)	181 (95.3)	175 (96.7)	39 (95.1)	8 (88.9)
Race n (%)	Non- Hispanic Whites	333 (71.3)	24 (55.8)	124 (65.3)	145 (79.7)	33 (76.7)	7 (77.8)
	Other	134 (28.7)	19 (44.2)	66 (34.7)	37 (20.3)	10 (23.3)	2 (22.2)
Position n (%)	Student	451 (97.6)	38 (90.5)	186 (98.4)	183 (100)	41 (95.4)	3 (60.0)
	Faculty	11 (2.4)	4 (9.5)	3 (1.6)	0 (0.0)	2 (4.6)	2 (40.0)

Appendix A 3: Baseline Knowledge Score of Pediatricians

	Score	High Scorers*	Low Scorers [†]
	Mean \pm SD	n (%)	n (%)
Total (n = 118)	21.1 \pm 6.0	16 (13.6)	102 (86.4)
General Knowledge	3.3 \pm 1.1	57 (48.3)	61 (51.7)
Preventable Knowledge	4.0 \pm 1.6	50 (42.4)	68 (57.6)
Dietary Knowledge	2.6 \pm 1.0	67 (56.8)	51 (43.2)
Oral-systemic Connection Knowledge	4.7 \pm 1.3	74 (62.7)	44 (37.3)
Confidence in Knowledge	6.4 \pm 4.1	5 (4.2)	113 (95.8)

*Those who scored >60% of the maximum score

[†]Those who scored \leq 60% of the maximum score

Appendix A 4: Pre-test (n = 204) versus Post-test (n = 175) Knowledge of Nurses

	Test	Mean \pm SD	% change [†]	High Scorers n (%)	Low Scorers n (%)	p-value [‡]
Total*	Pre	10.3 \pm 4.2	+ 122.3%	0 (0.0)	204 (100.0)	<u>≤ 0.01</u>
	Post	22.9 \pm 6.5		40 (22.9)	135 (77.1)	
General Knowledge	Pre	1.9 \pm 0.9	+ 63.2%	8 (3.9)	196 (96.1)	<u>≤ 0.01</u>
	Post	3.1 \pm 0.9		64 (36.6)	111 (63.4)	
Preventable Knowledge	Pre	2.8 \pm 1.5	+ 71.4%	27 (13.2)	177 (86.8)	<u>≤ 0.01</u>
	Post	4.8 \pm 1.5		109 (62.3)	66 (37.7)	
Dietary Knowledge	Pre	2.0 \pm 1.0	+ 65.0%	56 (27.4)	148 (72.6)	<u>≤ 0.01</u>
	Post	3.3 \pm 0.8		152 (86.9)	23 (13.1)	
Oral-systemic Connection Knowledge	Pre	2.7 \pm 1.6	+ 129.6%	32 (15.7)	172 (84.3)	<u>≤ 0.01</u>
	Post	6.2 \pm 1.2		159 (90.9)	16 (9.1)	
Confidence in Knowledge	Pre	0.9 \pm 1.4	+ 500.0%	0 (0.0)	204 (100.0)	<u>≤ 0.01</u>
	Post	5.4 \pm 5.0		14 (8.0)	161 (92.0)	

*Statistical significance difference ($p < 0.01$) using Two-way t-test

†(+ improvement, (-) reduction in means

‡Pearson Chi-square test comparing the number of high scorers versus low scorers

Appendix A 5: Pre-test (n = 204) versus Follow up-test (n = 57) Knowledge of Nurses

	Test	Mean \pm SD	% change [†]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Pre	10.3 \pm 4.2	+ 92.2	0 (0.0)	204 (100.0)	<u><0.01</u> [§]
	Follow up	19.8 \pm 6.7		5 (8.8)	52 (91.2)	
General Knowledge	Pre	1.9 \pm 0.9	+ 57.9	8 (3.9)	196 (96.1)	<u><0.01</u> [‡]
	Follow up	3.0 \pm 1.0		16 (28.1)	41 (71.9)	
Preventable Knowledge	Pre	2.8 \pm 1.5	+ 39.3	27 (13.2)	177 (86.8)	<u><0.01</u> [‡]
	Follow up	3.9 \pm 1.4		22 (38.6)	35 (61.4)	
Dietary Knowledge	Pre	2.0 \pm 1.0	+ 50.0	56 (27.4)	148 (72.6)	<u><0.01</u> [‡]
	Follow up	3.0 \pm 0.8		43 (75.4)	14 (24.6)	
Oral-systemic Connection Knowledge	Pre	2.7 \pm 1.6	+ 92.6	32 (15.7)	172 (84.3)	<u><0.01</u> [‡]
	Follow up	5.2 \pm 1.8		40 (70.2)	17 (29.8)	
Confidence in Knowledge	Pre	0.9 \pm 1.4	+ 422.2	0 (0.0)	204 (100.0)	<u>0.00</u> [§]
	Follow up	4.6 \pm 4.6		4 (7.0)	53 (93.0)	

*Statistical significance difference ($p < 0.01$) using Two-way t-test

†(+) improvement, (-) reduction in means

‡Pearson Chi-square test comparing the number of high scorers versus low scorers

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 6: Post-test (n = 175) versus Follow up-test (n = 57) Knowledge of Nurses

	Test	Mean \pm SD	% change [†]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Post	22.9 \pm 6.5	-13.5	40 (22.9)	135 (77.1)	<u>0.02</u> [‡]
	Follow up	19.8 \pm 6.7		5 (8.8)	52 (91.2)	
General Knowledge	Post	3.1 \pm 0.9	-3.2	64 (36.6)	111 (63.4)	0.24 [‡]
	Follow up	3.0 \pm 1.0		16 (28.1)	41 (71.9)	
Preventable Knowledge	Post	4.8 \pm 1.5	-18.8	109 (62.3)	66 (37.7)	<u>0.00</u> [‡]
	Follow up	3.9 \pm 1.4		22 (38.6)	35 (61.4)	
Dietary Knowledge	Post	3.3 \pm 0.8	-9.1	152 (86.9)	23 (13.1)	<u>0.04</u> [‡]
	Follow up	3.0 \pm 0.8		43 (75.4)	14 (24.6)	
Oral-systemic Connection Knowledge	Post	6.2 \pm 1.2	-16.1	159 (90.9)	16 (9.1)	<u><0.01</u> [‡]
	Follow up	5.2 \pm 1.8		40 (70.2)	17 (29.8)	

Confidence in Knowledge	Post	5.4 ± 5.0	-13.0	14 (8.0)	161 (92.0)	1.00 [§]
	Follow up	4.7 ± 4.6		4 (7.0)	53 (93.0)	

*Statistical significance difference (p = 0.00) using Two-way t-test

†(+) improvement, (-) reduction in means

‡Pearson Chi-square test comparing the number of high scorers versus low scorers

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 7: Pre-test (n = 141) versus Post-test (n = 145) Knowledge of SLPs (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	17.8 \pm 3.2	+ 18.0	119 (84.4)	22 (15.6)	<u>≤ 0.01</u>
	Post	21.0 \pm 2.6		140 (96.5)	5 (3.5)	
Oral-speech/hearing Connection Knowledge	Pre	11.9 \pm 2.7	+ 21.8	104 (73.8)	37 (26.2)	<u>≤ 0.01</u>
	Post	14.5 \pm 2.2		139 (95.9)	6 (4.1)	
Oral Health Perception	Pre	5.9 \pm 1.1	+ 8.5	127 (90.1)	14 (9.9)	<u>0.01</u>
	Post	6.4 \pm 0.9		141 (97.2)	4 (2.8)	

*Statistical significance difference (p<0.01) using Wilcoxon rank-sum test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Pearson Chi-square test comparing the number of high scorers versus low scorers

Appendix A 8: Pre-test (n = 107) versus Follow up-test (n = 64) Knowledge of SLPs (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	17.8 \pm 3.3	+ 12.4	90 (84.1)	17 (15.9)	<u>0.01</u>
	Follow up	20.0 \pm 3.1		62 (96.9)	2 (3.1)	
Oral-speech/hearing Connection Knowledge	Pre	12.0 \pm 2.8	+ 15.8	81 (75.7)	26 (24.3)	<u>0.02</u>
	Follow up	13.9 \pm 2.6		58 (90.6)	6 (9.4)	
Oral Health Perception	Pre	5.9 \pm 1.1	+ 3.4	95 (88.8)	12 (11.2)	0.47
	Follow up	6.1 \pm 1.0		59 (92.2)	5 (7.8)	

*Statistical significance difference (p<0.01) using Wilcoxon rank-sum test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Pearson Chi-square test comparing the number of high scorers versus low scorers

Appendix A 9: Post-test (n = 106) versus Follow up-test (n = 64) Knowledge of SLPs (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Post	20.9 \pm 2.7	-4.3	102 (96.2)	4 (3.8)	1.00
	Follow up	20 \pm 3.1		62 (96.9)	2 (3.1)	
Oral-speech/hearing Connection Knowledge	Post	14.6 \pm 2.3	-4.8	101 (95.3)	5 (4.7)	0.34
	Follow up	13.9 \pm 2.6		58 (90.6)	6 (9.4)	
Oral Health Perception	Post	6.4 \pm 0.9	-4.7	103 (97.2)	3 (2.8)	0.15
	Follow up	6.1 \pm 1.0		59 (92.2)	5 (7.8)	

*Non-statistical significance difference (p = 0.07) using Wilcoxon rank-sum test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 10: Pre-test (n = 111) versus Post-test (n = 115) Knowledge of SLPs (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	22.7 \pm 4.4	+ 32.6	77 (69.4)	34 (30.6)	<u><0.01</u>
	Post	30.1 \pm 3.1		114 (99.1)	1 (0.9)	
General Knowledge	Pre	1.6 \pm 0.8	+ 43.8	61 (55.0)	50 (45.0)	<u><0.01</u>
	Post	2.3 \pm 0.7		101 (87.8)	14 (12.2)	
Preventable Knowledge	Pre	1.4 \pm 0.9	+ 92.9	12 (10.8)	99 (89.2)	<u><0.01</u>
	Post	2.7 \pm 1.0		71 (61.7)	44 (38.3)	
Dietary Knowledge	Pre	1.3 \pm 0.7	+ 38.5	45 (40.5)	66 (59.5)	<u><0.01</u>
	Post	1.8 \pm 0.4		90 (78.3)	25 (21.7)	
Oral-systemic Connection Knowledge	Pre	1.1 \pm 1.0	+ 145.5	37 (33.3)	74 (66.7)	<u><0.01</u>
	Post	2.7 \pm 0.6		111 (96.5)	4 (3.5)	
Oral-speech/hearing Connection Knowledge	Pre	11.5 \pm 2.7	+ 22.6	78 (70.3)	33 (29.7)	<u><0.01</u>
	Post	14.1 \pm 2.2		109 (94.8)	6 (5.2)	

Oral Health Perception	Pre	5.8 ± 1.1	+ 10.3	99 (89.2)	12 (10.8)	<u>0.01</u>
	Post	6.4 ± 1.0		112 (97.4)	3 (2.6)	

*Statistical significance difference (p<0.01) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+) improvement, (-) reduction in means

§Pearson Chi-square test comparing the number of high scorers versus low scorers

Appendix A 11: Pre-test (n = 77) versus Follow up-test (n = 45) Knowledge of SLPs (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Pre	22.3 \pm 4.5	+ 27.8	49 (63.6)	28 (36.4)	<u><0.01</u> [§]
	Follow up	28.5 \pm 3.7		43 (95.6)	2 (4.4)	
General Knowledge	Pre	1.6 \pm 0.8	+ 18.8	42 (54.5)	35 (45.5)	0.07 [§]
	Follow up	1.9 \pm 0.7		32 (71.1)	13 (28.9)	
Preventable Knowledge	Pre	1.3 \pm 0.9	+ 76.9	7 (9.1)	70 (90.9)	<u><0.01</u> [§]
	Follow up	2.3 \pm 0.9		20 (44.4)	25 (55.6)	
Dietary Knowledge	Pre	1.1 \pm 0.7	+ 72.7	24 (31.2)	53 (68.8)	<u><0.01</u> [§]
	Follow up	1.9 \pm 0.3		39 (86.7)	6 (13.3)	
Oral-systemic Connection Knowledge	Pre	1.1 \pm 1.0	+ 118.2	26 (33.8)	51 (66.2)	<u><0.01</u> [§]
	Follow up	2.4 \pm 0.8		39 (86.7)	6 (13.3)	
Oral-speech/hearing Connection Knowledge	Pre	11.5 \pm 2.7	+ 20.0	55 (71.4)	22 (28.6)	<u>0.01</u> [§]
	Follow up	13.8 \pm 2.6		41 (91.1)	4 (8.9)	

Oral Health Perception	Pre	5.7 ± 1.1	+ 7.0	67 (87.0)	10 (13.0)	0.37 [‡]
	Follow up	6.1 ± 1.0		42 (93.3)	3 (6.7)	

*Statistical significance difference (p<0.01) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+/-) improvement, (-) reduction in means

§Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 12: Post-test (n = 76) versus Follow up-test (n = 45) Knowledge of SLPs (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Post	29.9 \pm 3.3	-4.7	75 (98.7)	1 (1.32)	0.56 [£]
	Follow up	28.5 \pm 3.7		43 (95.6)	2 (4.4)	
General Knowledge	Post	2.4 \pm 0.7	-20.8	67 (88.2)	9 (11.8)	0.02 [§]
	Follow up	1.9 \pm 0.7		32 (71.1)	13 (28.9)	
Preventable Knowledge	Post	2.8 \pm 1.1	-17.9	48 (63.2)	28 (36.8)	0.05 [§]
	Follow up	2.3 \pm 0.9		20 (44.4)	25 (55.6)	
Dietary Knowledge	Post	1.8 \pm 0.4	+ 5.6	60 (78.9)	16 (21.1)	0.29 [§]
	Follow up	1.9 \pm 0.3		39 (86.7)	6 (13.3)	
Oral-systemic Connection Knowledge	Post	2.7 \pm 0.6	-11.1	73 (96.1)	3 (3.9)	0.08 [£]
	Follow up	2.4 \pm 0.8		39 (86.7)	6 (13.3)	
Oral-speech/hearing Connection Knowledge	Post	14.0 \pm 2.3	-1.4	71 (93.4)	5 (6.6)	0.73 [£]
	Follow up	13.8 \pm 2.6		41 (91.1)	4 (8.9)	

Oral Health Perception	Post	6.3 ± 0.9	-3.2	74 (97.4)	2 (2.6)	0.36 [‡]
	Follow up	6.1 ± 1.0		42 (93.3)	6 (6.7)	

*Statistical significance difference ($p = 0.04$) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+), improvement, (-) reduction in means

§Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 13: Pre-test (n = 43) versus Post-test (n = 43) Knowledge of Nutritionists (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Pre	21.0 \pm 5.3	+ 36.7	17 (39.5)	26 (60.5)	<u><0.01</u> [§]
	Post	28.7 \pm 4.6		37 (86.0)	6 (14.0)	
General Knowledge	Pre	0.6 \pm 0.5	-16.7	26 (60.5)	17 (39.5)	0.51 [§]
	Post	0.5 \pm 0.5		23 (53.5)	20 (46.5)	
Dietary Knowledge	Pre	8.9 \pm 2.5	+ 10.1	33 (76.7)	10 (23.3)	0.42 [§]
	Post	9.8 \pm 2.1		36 (83.7)	7 (16.3)	
Oral-systemic Connection Knowledge	Pre	0.9 \pm 0.3	+ 11.1	40 (93.0)	3 (7.0)	0.62 [‡]
	Post	1.0 \pm 0.2		42 (97.7)	1 (2.3)	
Confidence in Knowledge	Pre	10.5 \pm 4.1	+ 64.8	5 (11.6)	38 (88.4)	<u><0.01</u> [§]
	Post	17.3 \pm 3.3		33 (76.7)	10 (23.3)	

*Statistical significance difference (P<0.01) using Two-way t-test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 14: Pre-test (n = 29) versus Follow up-test (n = 15) Knowledge of Nutritionists (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Pre	19.4 \pm 5.4	+ 34.5	10 (34.5)	19 (65.5)	<u>0.01</u> [§]
	Follow up	26.1 \pm 6.4		11 (73.3)	4 (26.7)	
General Knowledge	Pre	0.6 \pm 0.5	N/A	17 (58.6)	12 (41.4)	0.93 [§]
	Follow up	0.6 \pm 0.5		9 (60.0)	6 (40.0)	
Dietary Knowledge	Pre	8.1 \pm 2.7	+ 17.3	19 (65.5)	10 (34.5)	0.17 [‡]
	Follow up	9.5 \pm 1.8		13 (86.7)	2 (13.3)	
Oral-systemic Connection Knowledge	Pre	0.9 \pm 0.3	+ 11.1	26 (89.7)	3 (10.3)	0.54 [‡]
	Follow up	1.0 \pm 0.0		15 (100.0)	0 (0.0)	
Confidence in Knowledge	Pre	9.8 \pm 4.1	+ 80.6	3 (10.3)	26 (89.7)	<u>0.02</u> [‡]
	Follow up	14.9 \pm 4.8		7 (46.7)	8 (53.3)	

*Statistical significance difference (p = 0.00) using Wilcoxon rank-sum test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 15: Post-test (n = 29) versus Follow up-test (n = 15) Knowledge of Nutritionists (Pilot Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value****
Total*	Post	28.7 \pm 5.1	-9.1	24 (86.2)	4 (13.8)	0.41 [£]
	Follow up	26.1 \pm 6.4		11 (73.3)	4 (26.7)	
General Knowledge	Post	0.4 \pm 0.5	+ 50.0	13 (44.8)	16 (55.2)	0.34 [§]
	Follow up	0.6 \pm 0.5		9 (60.0)	6 (40.0)	
Dietary Knowledge	Post	9.9 \pm 2.3	-4.0	24 (82.8)	5 (17.2)	1.00 [£]
	Follow up	9.5 \pm 1.8		13 (86.7)	2 (13.3)	
Oral-systemic Connection Knowledge	Post	1.0 \pm 0.2	N/A	28 (96.5)	1 (3.5)	1.00 [£]
	Follow up	1.0 \pm 0.0		15 (100.0)	0 (0.0)	
Confidence in Knowledge	Post	17.4 \pm 3.7	-14.4	22 (75.9)	7 (24.1)	0.05 [§]
	Follow up	14.9 \pm 4.8		7 (46.7)	8 (53.3)	

*Non-statistical significance difference (p = 0.18) using Wilcoxon rank-sum test

[†]Mean for participants who are included in this comparison

[‡](+) improvement, (-) reduction in means

[§]Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 16: Pre-test (n = 29) versus Post-test (n = 29) Knowledge of Nutritionists (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	28.9 \pm 7.0	+ 46.4	7 (24.1)	22 (75.9)	<u><0.01</u>
	Post	42.3 \pm 5.7		28 (96.5)	1 (3.5)	
General Knowledge	Pre	1.7 \pm 0.6	+ 35.3	18 (62.1)	11 (37.9)	<u>0.01</u>
	Post	2.3 \pm 0.7		26 (89.7)	3 (10.3)	
Preventable Knowledge	Pre	2.0 \pm 1.0	+ 40.0	11 (37.9)	18 (62.1)	<u>0.00</u>
	Post	2.8 \pm 1.0		22 (75.9)	7 (24.1)	
Dietary Knowledge	Pre	10.3 \pm 2.8	+ 23.3	20 (69.0)	9 (31.0)	0.22
	Post	12.7 \pm 2.4		24 (82.8)	5 (17.2)	
Oral-systemic Connection Knowledge	Pre	2.6 \pm 1.1	+ 50	13 (44.8)	16 (55.2)	<u><0.01</u>
	Post	3.9 \pm 0.4		29 (100.0)	0 (0.0)	
Confidence in Knowledge	Pre	12.2 \pm 4.8	+ 68.9	5 (17.2)	24 (82.8)	<u><0.01</u>
	Post	20.6 \pm 4.1		22 (75.9)	7 (24.1)	

*Statistical significance difference ($P < 0.01$) using Two-way t-test

†Mean for participants who are included in this comparison

‡(+) improvement, (-) reduction in means

§Pearson Chi-square test comparing the number of high scorers versus low scorers

Appendix A 17: Pre-test (n = 29) versus Follow up-test (n = 15) Knowledge of Nutritionists (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value
Total*	Pre	28.9 \pm 7.0	+ 33.9	7 (24.1)	22 (75.9)	<u>0.00</u> [§]
	Follow up	38.7 \pm 7.4		11 (73.3)	4 (26.7)	
General Knowledge	Pre	1.7 \pm 0.6	+ 11.8	18 (62.1)	11 (37.9)	0.46 [§]
	Follow up	1.9 \pm 0.7		11 (73.3)	4 (26.7)	
Preventable Knowledge	Pre	2.0 \pm 1.0	+ 50.0	11 (37.9)	18 (62.1)	<u>0.01</u> [§]
	Follow up	3.0 \pm 0.8		12 (80.0)	3 (20.0)	
Dietary Knowledge	Pre	10.3 \pm 2.8	+ 18.4	20 (69.0)	9 (31.0)	0.28 [£]
	Follow up	12.2 \pm 1.8		13 (86.7)	2 (13.3)	
Oral-systemic Connection Knowledge	Pre	2.6 \pm 1.1	+ 46.2	13 (44.8)	16 (55.2)	<u><0.01</u> [§]
	Follow up	3.8 \pm 0.4		15 (100.0)	0 (0.0)	
Confidence in Knowledge	Pre	12.2 \pm 4.8	+ 45.1	5 (17.2)	24 (82.8)	<u>0.01</u> [£]
	Follow up	17.7 \pm 5.5		9 (60.0)	6 (40.0)	

*Statistical significance difference ($p < 0.01$) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+) improvement, (-) reduction in means

§Pearson Chi-square test comparing the number of high scorers versus low scorers

‡Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 18: Post-test (n = 29) versus Follow up-test (n = 15) Knowledge of Nutritionists (Final Questions)

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Post	42.3 \pm 5.7	-8.5	28 (96.6)	1 (3.5)	<u>0.04</u>
	Follow up	38.7 \pm 7.4		11 (73.3)	4 (26.7)	
General Knowledge	Post	2.3 \pm 0.7	-17.4	26 (89.7)	3 (10.3)	0.21
	Follow up	1.9 \pm 0.7		11 (73.3)	4 (26.7)	
Preventable Knowledge	Post	2.8 \pm 1.0	+ 7.1	22 (75.9)	7 (24.1)	1.00
	Follow up	3.0 \pm 0.8		12 (80.0)	3 (20.0)	
Dietary Knowledge	Post	12.7 \pm 2.4	-3.9	24 (82.8)	5 (17.2)	1.00
	Follow up	12.2 \pm 1.8		13 (86.7)	2 (13.3)	
Oral-systemic Connection Knowledge	Post	3.9 \pm 0.4	-2.6	29 (100.0)	0 (0.0)	N/A
	Follow up	3.8 \pm 0.4		15 (100.0)	0 (0.0)	
Confidence in Knowledge	Post	20.6 \pm 4.1	-14.1	22 (75.9)	7 (24.1)	0.31
	Follow up	17.7 \pm 5.5		9 (60.0)	6 (40.0)	

*Non-statistical significance difference ($p = 0.11$) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+ improvement, (-) reduction in means

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 19: Pre-test (n = 9) versus Post-test (n = 9) knowledge of Social Workers

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	24.9 \pm 5.0	+ 32.1	5 (55.6)	4 (44.4)	0.29
	Post	32.9 \pm 3.3		8 (88.9)	1 (11.1)	
General Knowledge	Pre	2.9 \pm 0.8	+ 17.2	2 (22.2)	7 (77.8)	0.62
	Post	3.4 \pm 0.9		4 (44.4)	5 (55.6)	
Dietary Knowledge	Pre	1.6 \pm 0.5	N/A	5 (55.6)	4 (44.4)	1.00
	Post	1.6 \pm 0.5		5 (55.6)	4 (44.4)	
Preventable Knowledge	Pre	2.1 \pm 1.3	+ 38.1	4 (44.4)	5 (55.6)	0.34
	Post	2.9 \pm 0.6		7 (77.8)	2 (22.2)	
Oral-systemic Connection Knowledge	Pre	0.9 \pm 0.3	+ 100	0 (0.0)	9 (100.0)	<u>0.00</u>
	Post	1.8 \pm 0.4		7 (77.8)	2 (22.2)	
Confidence in Knowledge	Pre	4.9 \pm 3.2	+ 81.6	2 (22.2)	7 (77.8)	0.06
	Post	8.9 \pm 1.8		7 (77.8)	2 (22.2)	

Abuse Knowledge	Pre	12.6 ± 4.3	+ 13.5	7 (77.8)	2 (22.2)	1.00
	Post	14.3 ± 3.4		8 (88.9)	1 (11.1)	

*Statistically significant difference (p = 0.00) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+ improvement, (-) reduction in means

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 20: Pre-test (n = 9) versus Follow up-test (n = 3) Knowledge of Social Workers

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Pre	24.9 \pm 5.0	+ 41.8	5 (55.6)	4 (44.4)	0.49
	Follow up	35.3 \pm 3.1		3 (100.0)	0 (0.0)	
General Knowledge	Pre	2.9 \pm 0.8	+ 3.4	2 (22.2)	7 (77.8)	1.00
	Follow up	3.0 \pm 1.0		1 (33.3)	2 (66.7)	
Dietary Knowledge	Pre	1.6 \pm 0.5	+ 25.0	5 (55.6)	4 (44.4)	0.49
	Follow up	2.0 \pm 0.0		3 (100.0)	0 (0.0)	
Preventable Knowledge	Pre	2.1 \pm 1.3	+ 28.6	4 (44.4)	5 (55.6)	1.00
	Follow up	2.7 \pm 0.6		2 (66.7)	1 (33.3)	
Oral-systemic Connection Knowledge	Pre	0.9 \pm 0.3	+ 122.2	0 (0.0)	9 (100.0)	<u>0.01</u>
	Follow up	2.0 \pm 0.0		3 (100.0)	0 (0.0)	
Confidence in Knowledge	Pre	4.9 \pm 3.2	+ 83.7	2 (22.2)	7 (77.8)	<u>0.05</u>
	Follow up	9.0 \pm 1.0		3 (100.0)	0 (0.0)	

Abuse Knowledge	Pre	12.6 ± 4.3	+ 32.5	7 (77.8)	2 (22.2)	1.00
	Follow up	16.7 ± 0.6		3 (100.0)	0 (0.0)	

*Statistically significant difference (p = 0.01) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+ improvement, (-) reduction in means

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 21: Post-test (n = 9) versus Follow up-test (n = 3) Knowledge of Social Workers

	Test	Mean \pm SD [†]	% change [‡]	High Scorers n (%)	Low Scorers n (%)	p-value [§]
Total*	Post	32.9 \pm 3.3	+ 7.3	8 (88.9)	1 (11.1)	1.00
	Follow up	35.3 \pm 3.1		3 (100.0)	0 (0.0)	
General Knowledge	Post	3.4 \pm 0.9	-11.8	4 (44.4)	5 (55.6)	1.00
	Follow up	3.0 \pm 1.0		1 (33.3)	2 (66.7)	
Dietary Knowledge	Post	1.6 \pm 0.5	+ 25.0	5 (55.6)	4 (44.4)	0.49
	Follow up	2.0 \pm 0.0		3 (100.0)	0 (0.0)	
Preventable Knowledge	Post	2.9 \pm 0.6	-6.9	7 (77.8)	2 (22.2)	1.00
	Follow up	2.7 \pm 0.6		2 (66.7)	1 (33.3)	
Oral-systemic Connection Knowledge	Post	1.8 \pm 0.4	+ 11.1	7 (77.8)	2 (22.2)	1.00
	Follow up	2.0 \pm 0.0		3 (100.0)	0 (0.0)	
Confidence in Knowledge	Post	8.9 \pm 1.8	+ 1.1	7 (77.8)	2 (22.2)	1.00
	Follow up	9.0 \pm 1.0		3 (100.0)	0 (0.0)	

Abuse Knowledge	Post	14.3 ± 3.4	+ 16.8	8 (88.9)	1 (11.1)	1.00
	Follow up	16.7 ± 0.6		3 (100.0)	0 (0.0)	

*Non-statistically significant difference ($p = 0.19$) using Wilcoxon rank-sum test

†Mean for participants who are included in this comparison

‡(+) improvement, (-) reduction in means

§Fisher's exact test comparing the number of high scorers versus low scorers

Appendix A 22: Summary of attitude Scores across Professions

	Mean * \pm SD	High Scorers n (%)
All Professions (n = 470)	85.1 \pm 6.7	470 (100.0)
Pediatricians (n = 45)	85.2 \pm 7.1	45 (100.0)
Nurses (n = 190)	83.7 \pm 6.7	190 (100.0)
Speech Language Pathologists (n = 183)	86.0 \pm 6.3	183 (100.0)
Nutritionists (n = 43)	86.9 \pm 6.8	43 (100.0)
Social Workers (n = 9)	88.4 \pm 5.5	9 (100.0)

*Statistical significance difference (p <0.01) using Kruskal-Wallis rank test

Appendix A 23: Multivariate Analysis to Evaluate the Relationship between Participants' Attitude and Previous IPE Experience when Controlling for Age and Race

<u>Attitude Score</u>	Coefficient	p-value*
<u>All professions combined: (n = 470)</u>		
No previous IPE experience	-2.2	<u><0.01</u>
Age	0.9	0.20
Race	1.6	<u>0.02</u>
<u>Pediatricians: (n = 45)</u>		
No previous IPE experience	-5.2	<u>0.04</u>
Age	1.3	0.54
Race	-3.1	0.16
<u>Nurses: (n = 190)</u>		
No previous IPE experience	-3.7	<u>0.03</u>
Age	2.4	<u>0.02</u>
Race	3.2	<u>0.00</u>

<u>Speech-Language Pathologists: (n = 183)</u>		
No previous IPE experience	-0.5	0.65
Age	0.5	0.66
Race	0.9	0.42
<u>Nutritionists: (n = 43)</u>		
No previous IPE experience	-0.9	0.75
Age	2.37	0.37
Race	-1.0	0.69
<u>Social Workers: (n = 9)</u>		
No previous IPE experience	0.0	N/A
Age	0.3	0.92
Race	3.7	0.35

*Linear regression models

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CURRICULUM VITAE

