

The Impact of School Based Oral Health Education Program on the Level of Oral Health Knowledge Among Public Intermediate School Girls at Riyadh, 2016

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Abstract

Objectives: This study was conducted to assess the impact of oral health education program on the level of oral health knowledge among female public intermediate school students in Riyadh. As well as to evaluate the correlation between their oral health knowledge and selected socio-demographic variables.

Methods: A pre-posttest quantitative study was conducted at public intermediate girls' schools in Riyadh. A sample of schools was selected using stratified random sampling technique to reflect the spectrum of intermediate schools under the Riyadh's educational regions (north, south, middle, east, and west). Five schools were randomly chosen from the department of education listings in each educational region. A total sample of 315 school students between the ages of 12 and 16 years completed the study. Permission to perform this study was received from the Institutional Review Board of King Saud University and Ministry of Education. A 15-item self-administered questionnaire was designed in Arabic language and used to assess the student's oral health knowledge. Followed by the intervention which consisted of 40 minutes interactive lecture using power point presentation presented by the investigator. The impact of the oral health education program was evaluated by measuring the change in the level of oral health knowledge one month after the program implementation. The data obtained from the questionnaire were entered into a Statistical Package for Social Sciences database (IBM, SPSS version 23, IL, USA). Descriptive statistics were used in calculating the frequency and percentage for categorical socio-demographic characteristics.

Mean and standard deviation (SD) were calculated for the continuous variables e.g. age, total score of knowledge. The impact of the program was estimated by calculating the percentage of change in the oral health knowledge which is calculated by $100 \times (\text{post test score} - \text{pretest score}) / \text{post test score}$. McNemar's Chi-square test was used to compare correct / incorrect responses to oral health based questions before and one month after the program implementation. Student t-test and one way analysis of variance (ANOVA) were applied to compare responses to oral health questions in relation to selected socio-demographic variables. A p-value of <0.05 was used to report the statistical significance of results.

Results: Three hundred and eighty questionnaires were distributed, out of which three hundred and fifteen were completed giving a response rate of 82.8%. Among the 315 students, 30.8% were first graders, 32.7% second graders, and 36.5% third graders. Nearly 80% of the participants were Saudis and the remaining were non-Saudis. The age range of the participants was 12-16 years with a mean age of 13.98 ± 1.094 . Prior to the implementation of the educational program, the question regarding the indication to remove dental plaque and calculus at the dental clinic, received the lowest percentage of correct answers (13.3%). Regarding the knowledge of the number of permanent teeth, only 24.1% of the respondents knew the correct number of permanent teeth. With regards to the knowledge of the external layer covering the teeth, only 27.3% of the sample gave a correct answer. Only 28.6% of the participants knew the importance of routine dental visits. About 30% of the respondents knew the correct indication for a dentist to do root canal treatment. The results showed that the oral health education program was effective at improving participant's oral health knowledge.

Overall, the baseline mean knowledge score was 4.79 ± 2.09 and one month after the intervention the mean knowledge score increased to 8.91 ± 1.7 . There was a statistically significant increase in the oral health knowledge after the program implementation by 45.4% ($P < 0.0001$).

Conclusion: This study showed that a school based oral health education program had a positive effect on the student's oral health knowledge. The benefits of such programs can be expanded with continuous school-based oral health programs involving oral health providers, school personnel's, parents, and their children.

Keywords: Oral health; Oral health programme; Oral health knowledge

Introduction

Oral health

Health is a common theme in most cultures and is a fundamental human right without distinction of race, religion, and political belief, economic and social condition [1]. Oral health is a standard of health of the oral and related tissues that enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and contributes to the general well-being. It is concerned with maintaining the health of craniofacial complex, the teeth and gums, as well as the tissue of the face and head that surrounds the mouth [2].

Dental caries

Oral diseases are common in many societies globally, with dental caries (DC) being the most prevalent chronic disease among children [3]. Low-income, middle-income and high-income countries, are affected by DC. It affects between 60% and 90% of children in industrialized countries [4]. The United States Surgeon General report on oral health stated that oral health problems are five times more likely to occur in children than asthma and seven times more than hay fever [5]. DC is an infectious disease that can affect infants, children, adults and elderly. DC can result in the inflammation of dental pulp and associated tissues which can ultimately lead to tooth loss, cellulitis and rarely to brain abscess [6]. Oral streptococci the causative bacteria of DC is known to be associated with systemic diseases such as endocarditis, meningitis, hepatic disease, and vertebral osteomyelitis [7]. DC is a debilitating condition that can cause a child to suffer a significant degree of pain [8]. If left untreated the disease may lead to further complications including sepsis [9]. Severe untreated caries has also been found to have links to general health and well-being, affecting young children's body weight and growth [10]. DC is painful, expensive to treat, and can harm the nutrition and overall health of a child.

It is particularly critical because even following repair, destroyed tooth structure exhibits increased vulnerability [10]. Furthermore, poor oral health impacts children's development. Toddlers may exhibit poor growth and nutrition when chewing is painful. Older children may miss school days or be distracted due to dental pain. Young people may interact less with their peers and society when they are uncomfortable or embarrassed by the appearance of their teeth [11]. The effects of DC on growth and physical, social/emotional, and cognitive development have implications on success and productivity throughout life [12]. DC occurs as a result of a complex interplay of social, cultural, behavioral, dietary and biological risk factors. Poor oral hygiene, high magnitude of cariogenic microorganisms, reduced saliva, inadequate exposure to fluoride, low socioeconomic status, and improper feeding habits in infants are risk factors for DC [13]. In children, the consumption of sugar containing food, socioeconomic status and poor perception about oral health of the mother are strongly associated with dental caries [14]. Dental caries, though preventable, is the most prevalent oral condition which can have huge public health impact on the oral and systemic health, social well-being, income of individuals and health care systems [15]. Additionally, good oral health is important in terms of the psychosocial factors which relate to quality of life and optimum social functioning including self-expression and communication [16]. The prevalence of dental caries has shown a dramatic decline over the past decades among children and adolescents in developed countries [17]. This reduction may be attributed to several factors such as improved oral hygiene practices,

effective use of fluorides, modification of dietary habits and consumption of sweets as well as the establishment of school-based preventive oral care programs [17]. In contrast, increased levels of DC were reported in some developing countries particularly those countries which have not established any preventive dental programs [18]. Of the oral health behaviors, regular tooth brushing with fluoridated toothpaste at least two times a day is the most important, together with the use of the dental floss once daily to clean interproximal surfaces. Reduction of the consumption of sweets, and regular visits to dentist twice a year are essentials for preventing DC and maintaining optimum oral health [19]. During the adolescent years, young individuals learn and acquire health related attitudes and behaviors that continue with them into their adulthood. It was found that relatively stable patterns of tooth brushing and dietary behaviors are usually established during the childhood and adolescence period [20].

Global burden of dental caries

Data collected from the National Health and Nutrition Examination Survey (1999-2004) in the United States showed that about 28% of children 2-5 years had DC in primary teeth while about 51% of children aged 6-11 years had DC in primary teeth, and 21% of them had DC in their permanent teeth [21]. A cross-sectional study comprising a sample of 2014 preschool Chinese children aged 3-5 years reported DC prevalence of 55% among them [22]. Similarly, a study involving 1487 children ages from birth - 5 years in Southern Brazil showed that 40% of preschoolers had DC in their primary teeth [23]. A nationwide health survey conducted in 2002-2003 in India found that about 52% of 5-year-old children had DC, while 54% of the 12 year olds and 63% of the 15 year olds of adolescents had DC [24]. A study conducted among a sample of high school students, found the prevalence of DC in Qazvin, Iran to be 75.5% [25]. Nibras and his colleagues found DC prevalence to be 62% among 12-year-old schoolchildren in Baghdad, Iraq [26]. The prevalence of DC among 12-14 year old children in Qatar was found to be 85% [27].

Dental caries in Saudi Arabia

In Saudi Arabia, dental caries rates are increasing with time. Al-Sekait and Al-Nasser examined a sample of 7040 primary school children from urban and rural schools in Riyadh, revealing a dental caries prevalence of 52% and a Decayed-Missed-Filled-Teeth (DMFT) index score of 2.0 [28]. Akpata and Al-Shammery examined all 12 and 13 year old students in 10 randomly selected Riyadh schools (5 boys' schools and 5 girls' schools) and found that the dental caries prevalence was between 55.5% (for 13-year-old boys) and 73.1% (for 12-year-old girls) [29]. A study was conducted in 1999 to assess the dental caries prevalence among 12-13 year old children in 10 of the 13 administrative regions in Saudi Arabia. The investigators randomly selected schools stratified by municipality and socioeconomic status and assessed random classes of students. The study found that the prevalence of dental caries was 74% in urban areas and 67% in rural areas, and there was a statistically significant difference between them ($P < 0.01$) [30]. Wyne also studied the occurrence of DC among 12-13 year old students and 18-19 year old students in randomly selected primary and intermediate schools in Riyadh. The dental caries prevalence was found to be 90.5% for the 12-13 year old students and 90.9% for the 15-19 year old students [31]. Around the same time, Al-Dosari and his team evaluated the dental caries prevalence in Riyadh school children and found it to be 91.2% among 6-7 year old children

and 92.3% among 12-13 year old children [32]. In 2004 Al-Wazzan investigated the magnitude and severity of dental caries prevalence in 6-7 year-old schoolchildren in Riyadh, only 5.6% of the total sample was free of dental caries indicating that prevalence of dental caries was 94.4% [33]. Al-Sadhan observed a dental caries prevalence of 93.7% and a mean DMFT score of 5.94 among 12-14 year-old schoolchildren in Riyadh [34].

Al-Malik & Rehbbini, studied a random sample of 300 children aged 6 to 7 years old drawn from six schools of military dependents in Jeddah, Saudi Arabia. Dental caries was found in 96% of the children [35]. The study highlighted the extent of dental disease in this community, which reflected the high treatment needs that cannot be met by traditional ways [35]. All these studies showed that various age groups in Saudi Arabia demonstrated a high prevalence and greater severity of dental caries, and trends also show a striking increase in DMFT and dental caries prevalence rates over the past few decades [15]. Preventive measures can be conducted in order to reduce the levels of dental caries in the country. The collaboration of dental caries prevention programs with national public health programs is considered the most effective strategy [36]. Reduction in the consumption of sugar containing foods, provision of community water fluoridation, school/community based topical fluoride application programs, availability of fluoride containing toothpastes, and oral health education and promotion are the most important dental caries preventive measures [15]. Childhood dental caries is a serious dental public health problem that warrants an immediate attention of the government and the dental profession officials in Saudi Arabia. Although many school based oral health educational programs are carried out every year in Riyadh by dental college students as community service graduation projects. No published studies evaluating the effectiveness of these programs are yet available.

Oral Health Knowledge, Attitude, and Practice in Saudi Arabia

Studies on attitudes toward oral hygiene in Saudi Arabia have shown that the attitude of school children toward oral hygiene remains negative, and there have been calls for the introduction of school based oral hygiene education [37]. Amin and Alabad assessed the frequency of consumption of cariogenic foods, oral hygiene practices and dental health knowledge of 1115 Saudi male students from 18 public primary schools in Al-Ahassa. The clinically decayed teeth were diagnosed in 68.9% of the children, more in urban and younger students. Only 24.5% of the students brushed their teeth twice or more per day, and 29% of the sample never received instructions regarding oral hygiene. Poor oral hygiene practices, lack of parental guidance and lack of appropriate dental health knowledge with frequent exposure to cariogenic foods in addition to socio-demographics were found to be the main risk factors for dental caries among the surveyed students [38]. Quadri and his colleagues studied the knowledge, attitudes and practices of sweet food and beverage consumption and its association with dental caries among schoolchildren in 853 children aged 6-15 years in Jazan by a questionnaire and clinical examinations. They found that the dental caries prevalence was 91.3%. While the knowledge was generally good, 83.5% of the surveyed boys and 85.8% of the girls had poor attitudes to sweet foods and more than 90% of the sample frequently consumed sweet foods/beverages [39].

Oral health education

Health promotion is the process of enabling people to increase control over and to improve their health [40]. Oral health education is an important part of oral health promotion and is an essential and basic part of oral health services [41]. Since the 1900s, oral health education has been considered an important and integral part of dental health services and has been delivered to individuals and groups in settings such as dental practice, schools, the workplace, and day-care and residential settings for older adults. The population as a whole has also been targeted using mass-media campaigns [42]. The educational interventions used have varied considerably, from the simple provision of information to the use of complex programs involving psychological and behavior-change strategies [42]. The goals of the interventions have also been broad, so that knowledge, attitudes, intentions, beliefs, behaviors, use of dental services and oral health status have all been targeted for change [42]. Oral health education aims to promote oral health through educational means, principally the provision of information to improve oral health knowledge for adoption of a healthier lifestyle, change attitudes and desirable behaviors [43]. Oral health education is essential for promoting oral health in adolescents [44]. During adolescence, young people are able to assume responsibility for learning and maintaining health-related attitudes and behaviors that carry over into adulthood [45]. The school system is a logical environment in which to teach preventive oral health practices and promote oral health [46]. A school is a closed environment that concentrates a considerable number of individuals of the same age group who regularly attend the institution. For this reason, it has been considered ideal for developing health and oral hygiene programs with children in age groups that are favorable for adopting preventive measures [47]. Moreover, oral health behavior is a result of a lifelong learning process, this process can best be achieved by an interdisciplinary collaboration among dentists and professionals in other areas, such as psychologists and teachers [48].

Effectiveness of School Based Oral Health Education Programs

In order to control the growing burden of oral diseases, a number of developing countries introduced a school-based oral health education programs and preventive programs which aim at improving oral health behavior and status of the child population. The initial evaluations from such programs conducted in Brazil [49], Indonesia [50], and Madagascar [51] have disclosed some encouraging results. According to Kay and Locker educational oral health programs have a small positive effect, which temporarily reduces dental plaque, and there is no impact on dental caries. In the same way, awareness levels can almost always be improved by oral health promotion initiatives. However, whether these shifts in knowledge and attitudes can be causally related to changes in behavior or clinical indices of disease has not yet been established [52]. A systematic review indicated that knowledge and attitudes could be improved through oral health education, with one study showing positive effects [42]. Tolvanen and his team reported that children in the experimental group of a randomized controlled trial tended to improve their behavior more than did those in the control group. Children in the experimental group (n=250) were offered an individualized regimen for dental caries control, aiming to identify and eliminate those factors that had led to the presence of active dental caries. The authors concluded that the oral health-promotion program can improve oral health-related behavior but has less effect on improvement of attitudes [53]. It is

surmised that well-designed educational intervention studies may improve oral hygiene indices and awareness levels in children, although this does not imply an effective change in habits [54]. The impact of oral health education (Lecture using PowerPoint presentation) on oral hygiene knowledge, practices, plaque control and gingival health of 13- to 15-year-old school children was studied in Bangalore city [55]. Nine months post-intervention, there was a significant improvement in oral hygiene knowledge and practices among the experimental groups. There were significant reductions in the mean scores of plaque index and gingival index among the experimental groups. It was concluded that active involvement of school children with reinforcement of oral health education can improve oral hygiene knowledge, practices and gingival health and decrease plaque level [55].

Effectiveness of School Based Oral Health Education Programs in Saudi Arabia

Elfaki and her team assessed the impact of health education program on promoting knowledge and practices among school age children in Najran, Saudi Arabia. Two hundred and nine students out of 288 students examined had dental caries with a prevalence rate of 72.6%. About two thirds of the examined students didn't know the causes of dental caries and 70% of the respondents had no idea about fluoridated toothpastes [56]. The study also revealed that 37% of the students got their dental health knowledge from their parents. After conducting the health education program all students became aware of the causes of dental caries and their knowledge was significantly improved ($p < 0.01$). Also the students' knowledge about fluoridated toothpastes and their importance in combating dental caries was significantly increased ($p < 0.01$) [56]. The evaluation of the impact of a school-based oral hygiene instructions program on the gingival health of children in randomly selected middle schools in Riyadh, Saudi Arabia was conducted 2015. The continued reduction of gingival index and plaque index scores at the end of the intervention observed in this study suggested that a school-based oral hygiene measures program can significantly improve oral health among school children [57].

Aim and Objectives

Aim

To assess the impact of school based oral health education program on the level of oral health knowledge among public intermediate school girls in Riyadh.

Objectives

- To assess the pretest oral health knowledge of public intermediate school girls in Riyadh.
- To assess posttest oral health knowledge of public intermediate school girls in Riyadh.
- To compare pretest and posttest oral health knowledge of public intermediate school girls in Riyadh.
- To evaluate the correlation between their oral health knowledge and selected socio-demographic variables.

Rationale

- High prevalence of dental caries among Saudi school children.

- In Saudi Arabia, there are many costly oral health educational programs applied for schoolchildren.
- There is lack of studies describing the effect of these programs on the short and long term knowledge, attitude and practice in Riyadh, KSA.

Research question

Is school based oral health education program effective at improving oral health knowledge among intermediate school girls in Riyadh?

Hypothesis

Based on the reviewed literature, it is hypothesized that school based oral health education program will be effective at improving the oral health knowledge among intermediate school girls students by 20%.

Significance

At the end of this study, if the expected outcome is achieved, this will benefit all the students and their families. This study can provide a foundation for the development of a permanent school based oral health education program to control dental caries in the dental public health practice in Saudi Arabia.

Material and Methods

Research design and setting

Research design: This study was a pre-posttest quantitative study.

Research setting: The study was conducted at public intermediate girls' schools in Riyadh. A school from each of the five educational regions of Riyadh was randomly selected.

Sampling & study population

Sample size calculation: At $\alpha = 0.05$, power = 0.8, $\beta = 0.2$, with estimated standard deviation = 2, mean difference = 3 from the pilot study. The sample size required was at least 300 students. Considering dropouts, the total sample required was increased to 380 students. The final sample of students completed the study was 315 student.

Sampling Technique: All public Intermediate girls' schools students in Riyadh provided the sample frame for this research. A sample of these schools was selected using stratified random sampling technique to reflect the spectrum of Intermediate schools under the Riyadh's educational regions (north, south, middle, east, and west). Five schools were randomly chosen from the department of education listings in each educational region. One class from each of the three grades was randomly selected from each school. The sample consisted of 315 intermediate school female students 12 to 16 year olds (first, second, third grade).

Inclusion and exclusion criteria

Inclusion criteria: Students of sampled public intermediate schools in Riyadh.

Exclusion criteria: Student refusing to participate in the study.

Definitions of intervention/outcome

Intervention: The intervention consisted of 40 minutes interactive lecture using power point presentation presented by the investigator.

Measured Outcome: The impact of the oral health education program was evaluated by measuring the change in the level of oral health knowledge one month after the program implementation. The impact of the program was estimated by calculating the percentage of change in the oral health knowledge which is calculated by $100 \text{ (post test score - pretest score) / post test score}$.

Pilot study

Clarity and validity of the questionnaire were assessed on 50 students before the operational study.

Data collection instrument

A 15-item self-administered questionnaire was designed in Arabic language. Distribution of the questionnaire was conducted during class period under the supervision of the investigator and one of the school teachers. Dental public health experts, social expert, and a representative group of the intermediate school students assessed the questionnaire for its content validity. The questionnaire (Appendix 4) was composed of two sections:

Section A: It was designed to collect information on the socio-demographic factors (Age, nationality, grade, mother's level of education, father's level of education).

Section B: There were 11 multiple choice questions which contained basic information about oral health, oral hygiene practices and tooth anatomy. The questions included the following: the number of permanent teeth, layers of the tooth, recommended frequency of tooth brushing per day, recommended frequency of replacing the tooth brush, importance of using the dental floss, the recommended frequency of dental check-ups, role of sweets and soft drinks in dental caries, dental caries and gingivitis including their causes and signs and symptoms, and the fluoride role in preventing dental caries.

Field work experience

The impact evaluation study was designed to assess the impact of school based oral health education program on the level of oral health knowledge. The school visits took place from 1 February to 30 March 2016. Prior appointments for the program were obtained from the school authorities. Students were arranged into groups (usually class wise), not exceeding 30 per each session. A baseline questionnaire was completed by the students in the classrooms. Followed by the intervention which consisted of 40 minutes interactive lecture using power point presentation presented by the investigator. The oral health education program covered five main topics. The first part reminded students of the functional and psychosocial role of healthy teeth and the importance of taking care of them. The second part was about human dentition including some practical aspects of the anatomy of the tooth (e.g. parts and layers of teeth), the number of permanent teeth. The third and fourth topics discussed the natural history of dental caries, chronic gingivitis including their causes, signs and symptoms. The last part covered caries preventive measures including brushing twice daily with fluoridated tooth paste using a soft tooth brush, using the dental floss once daily, reducing the amount and frequency of sweets intake, consuming protective foods e.g. cheese, peanuts as snacks and the importance of regular visits to the dentist

and application of preventive measures e.g. fluoride, pits and fissures sealants. The oral health educational program covered all topics in the questionnaire and emphasized on the following three messages (brushing teeth twice per day, healthy diet, and regular dental visit twice per year).

At the end of the session, 10 minutes were assigned for discussion and answering the student's questions. One month post-intervention, the same questionnaire was administered to assess any improvement in oral health knowledge (correct answers).

Ethical considerations

Permission to perform this research was received from the Institutional Review Board of King Saud University, Riyadh, Saudi Arabia (Research Project No. E-15-1727), and Ministry of Education. The Institutional Review Board approval (Appendix 1). Ministry of Education approval (Appendix 2). All participants received a clear written informed consent (Appendix 3) which indicates:

- Purpose of the study.
- Right of the participant to withdraw at any time.
- Confidentiality of the collected data and that it will be used only for research purposes and assuring the participant will remain anonymous in any publication.

Statistical Analysis

The data obtained from the questionnaire were entered into a Statistical Package for Social Sciences database (IBM, SPSS version 23, IL, USA). Descriptive statistics were used in calculating frequency and percentage for socio-demographics characteristics distribution (nationality, grades, area of residence, parents' educational level). Descriptive statistics were used in calculating mean and standard deviation (SD) for the continuous variables e.g. age, total score of knowledge. The questionnaire comprised of 11 knowledge-based questions. The total score of oral health knowledge was calculated. Right answer for knowledge of oral health was given a score of 1, and wrong answer was scored 0. Scores of all 11 knowledge questions were summed up to get the total score for each participant (before and one month after the program). As all before and after intervention and difference in total score of oral health knowledge were approximately normally distributed, parametric tests were applied. McNemar's Chi-square test used to compare correct/incorrect responses to oral health questions before and one month after the program implementation. Student t-test for independent samples was used to compare responses to oral health questions in relation to two categories study variable e.g. nationality. One way analysis of variance (ANOVA) was applied to compare responses to oral health questions in relation to more than two categories study variable grades, area of residence, and parents' educational level followed by post-hoc Tukey multiple pairwise comparison.

To evaluate the impact of the oral health education program, the percentage of change in the knowledge was calculated by $100 \text{ (post test score - pretest score) / post test score}$. A p-value of <0.05 was used to report the statistical significance of results.

Results

Three hundred and eighty questionnaires were distributed, out of which three hundred and fifteen were completed giving a response rate of 82.8%. Among the 315 students, 30.8% were first graders, 32.7%

second graders, and 36.5% third graders. Nearly 80% of the participants were Saudis and the remaining were non-Saudis. The age range of the participants was 12-16 years with a mean age of 13.98 ± 1.094 . The socio-demographic data of the sample are summarized in Table 1. The questionnaire comprised of 11 knowledge-based questions. Prior to the implementation of the educational program, the question regarding the indication to remove dental plaque and calculus at the dental clinic, received the lowest percentage of correct answers (13.3%). Regarding the knowledge of the number of permanent teeth, only 24.1% of the respondents knew the correct number of permanent teeth. With regards to the knowledge of the external layer covering the teeth, only 27.3% of the sample gave a correct answer. Only 28.6% of

the participants knew the importance of routine dental visits. About 30% of the respondents knew the correct indication for a dentist to do root canal treatment. Nearly 45% of the participants knew that fluoride is an anti-cariogenic component of the toothpaste. The majority of the sample were able to recognize the negative effect of sweets and soft drinks on dental health, (86.3% and 69.2% respectively). About 60% of the participants were aware of the importance of brushing the teeth at least twice daily for dental caries prevention. Approximately half of the participants knew correctly the recommended frequency of replacing the tooth brush. Distribution of the participants' responses to oral health knowledge questions before and after the oral health education program implementation are presented in Table 2.

Factor	Categories	Frequency	Percentage
Age/Years	12 years	31	9.8%
	13 years	74	23.5%
	14 years	104	33%
	15 years	82	26%
	16 years	24	7.6%
	Mean \pm SD=13.98 \pm 1.094		
Nationality	Saudi	249	79%
	Non-Saudi	66	21%
Student's Grade	First grade	97	30.8%
	Second grade	103	32.7%
	Third grade	115	36.5%
Area of Residence	North	58	18.4%
	South	59	18.7%
	Middle	66	21%
	East	65	20.6%
	West	67	21.3%
Parents' Educational Level	Both parents with low education	123	43.8%
	Mother low & father high education	60	21.4%
	Father low & mother high education	8	2.8%
	Both parents with high education	90	32%

Table 1: Socio-Demographic data of the sample of intermediate school girls in Riyadh, 2016 (n=315).

Statistically significant improvements in the oral health knowledge level were observed after the oral health education program implementation ($P < 0.0001$) (Table 3). The lowest levels of improvement in the post-intervention questionnaire were found in the questions which were about the negative effect of sweets and soft drinks on dental health. While the highest levels of improvement were in the questions which were about the indication for a dentist to do root canal treatment, number of permanent teeth, and the external layer covering the teeth. No statistically significant differences were found in the baseline oral health knowledge between Saudis and non-Saudi students. However, Saudi students showed a statistically

significant improvement in their oral health knowledge level after the program implementation ($P = 0.023$) (Table 4). No statistically significant differences were apparent between the different grades in the level of oral health knowledge before the intervention program. However, second grade students performed better in the post-intervention questionnaire ($P = 0.004$). Statistically significant differences in the mean score of oral health knowledge were found between students from different areas of residence before the implementation of the program, as students from the western region of Riyadh demonstrated the highest level of oral health knowledge among the surveyed students while students from the eastern and southern

regions presented with the lowest level of oral health knowledge ($P < 0.0001$).

Questions/Statements	Pre-Intervention responses		Post-Intervention responses		P-value
	Correct	Incorrect	Correct	Incorrect	
Total number of permanent teeth	76 (24.1%)	239 (75.9%)	239 (75.9%)	76 (24.1%)	<0.0001
External hard layer of teeth	86 (27.3%)	229 (72.7%)	246 (78.1%)	69 (21.9%)	<0.0001
Brush teeth at least twice per day	186(59%)	129(41%)	315(100%)	-	-
Frequency of replacing dental brush	153(48.6%)	162(51.4%)	260(82.5%)	55(17.5%)	<0.0001
Sweets have negative effect on dental health	272(86.3%)	43(13.7%)	287(91.1%)	28(8.9%)	0.049
Soft drinks have negative effect on dental health	218(69.2%)	97(30.8%)	275(87.3%)	40(12.7%)	<0.0001
Dental visits	90(28.6%)	22(71.4%)	232(73.7%)	83(26.3%)	<0.0001
Anti-Cariogenic component of tooth paste	142(45.1%)	173(54.9%)	262(83.2%)	53(16.8%)	<0.0001
Dental floss use	152(48.3%)	163(51.7%)	250(79.4%)	65(20.6%)	<0.0001
An indication for a dentist to remove dental plaque and calculus	42(13.3%)	273(86.7%)	166(52.7%)	149(47.3%)	<0.0001
An indication for a dentist to do root canal treatment	93(29.5%)	222(70.5%)	274(87%)	41(13%)	<0.0001

Table 2: Distribution of participants' responses to oral health knowledge questions before and after the oral health education program (n=315).

	Mean score of knowledge \pm SD (Before)	Mean score of knowledge \pm SD (After)	Mean Difference \pm SD	95% C.I for difference of mean	t-value	p-value
Total score of oral health knowledge	4.79 \pm 2.09	8.91 \pm 1.7	4.11 \pm 2.28	(3.8 - 4.3)	- 31.97	<0.0001
*Paired sample t-test						

Table 3: Comparison of mean score \pm SD of oral health knowledge before and one month after the oral health education program implementation.

Nationality	Mean score of knowledge \pm SD (Before)	Mean score of knowledge \pm SD (After)	Mean difference \pm SD	95% C.I for difference of mean
Saudis	4.7 \pm 2.01	8.9 \pm 1.6	4.26 \pm 2.19	(3.9 - 4.5)
Non-Saudis	5.06 \pm 2.3	8.6 \pm 1.8	3.5 \pm 2.5	(2.9 - 4.1)
t-value	-1.16	1.6	2.29	
p-value	0.245	0.106	0.023	
*Independent samples t-test				

Table 4: Comparison of mean score \pm SD of oral health knowledge before and one month after the oral health education program with respect to student's nationality.

After the program implementation, the highest level of improvement in the oral health knowledge was observed in Riyadh's eastern region (Table 5).

Regarding the parents educational level, statistically significant differences in the level of oral health knowledge were found between students who both parents were highly educated compared to students whose both parents had low educational levels both at baseline and in the post-intervention questionnaires ($P < 0.0001$). Table 5 illustrates the

comparison of mean scores \pm SD of oral health knowledge before and one month after the oral health education program with respect to the different socio-demographic variables. The impact of the program was estimated by calculating the percentage of change in the oral health knowledge. The mean improvement in oral health knowledge was found to be $45.4\% \pm 24.4\%$ with 95% (C.I) confidence interval (42.7-48.1).

Socio-Demographic Variable	Categories	Mean score of knowledge \pm SD (Before)	Mean score of knowledge \pm SD (After)	Mean difference \pm SD	95% C.I for difference of mean
1- Student's Grade	First	4.6 \pm 2.1	8.8 \pm 1.5	4.27 \pm 2.4	(3.7- 4.7)
	Second	5.1 \pm 2.2	9.3 \pm 1.6	4.21 \pm 2.4	(3.7- 4.6)
	Third	4.6 \pm 1.9	8.5 \pm 1.8	3.88 \pm 2.0	(3.5- 4.2)
	f-value	1.727	5.7	0.917	
	p-value	0.18	0.004	0.4	
2- Area of Residence	West	6.98 \pm 1.69	9.7 \pm 1.3	2.77 \pm 2.2	(2.2- 3.3)
	Middle	4.71 \pm 1.9	8.6 \pm 1.7	3.98 \pm 2.15	(3.4- 4.5)
	North	4.48 \pm 1.9	8.7 \pm 1.6	4.22 \pm 2.12	(3.6- 4.7)
	East	4.01 \pm 1.4	9.5 \pm 1.39	5.49 \pm 1.8	(5.04-5.9)
	South	3.55 \pm 1.5	7.2 \pm 1.7	4.15 \pm 2.17	(3.5-4.7)
	f-value	38.3	16.7	13.65	
	p-value	<0.0001	<0.0001	<0.0001	
3- Parents' Educational Level	Both parents with low education	4.14 \pm 1.7	8.5 \pm 1.7	4.3 \pm 2.1	(3.9-4.7)
	Mother low & father high education	5.83 \pm 2.7	9.03 \pm 1.6	3.2 \pm 2.8	(2.4-3.9)
	Father low & mother high education	5.37 \pm 2.7	7.2 \pm 2.7	1.8 \pm 2.4	(-0.14-3.8)
	Both parents with high education	5.35 \pm 1.6	9.5 \pm 1.2	4.2 \pm 1.9	(3.7-4.2)
	f-value	11.8	10.3	6.26	
	p-value	<0.0001	<0.0001	<0.0001	

* Analysis of variance (ANOVA) post-hoc Tukey multiple pairwise comparison.

Table 5: Comparison of mean scores \pm SD of oral health knowledge before and one month after the oral health education program implementation with respect to different socio-demographic variables.

Discussion

This study was conducted to evaluate the impact of school based oral health education program on the level of oral health knowledge among public intermediate school girls at Riyadh. The results showed that the oral health education program was effective at improving participant's oral health knowledge. Overall, the baseline mean knowledge score was 4.79 ± 2.09 and after the intervention (one month later), the mean knowledge increased to 8.91 ± 1.7 . There was a statistically significant increase in the oral health knowledge after the program implementation by 45.4% ($P < 0.0001$). Similar results were

observed in a study carried out by Biesbrock and his colleagues in the United States, where they found a statistically significant increase in the information on oral health habits after their educational program implementation ($P < 0.05$) [44]. Similarly, Aquilante and his colleagues in an educational intervention study performed in Brazil found an increased oral health awareness level their educational program ($P < 0.001$) [58]. D'Cruz and Aradhya concluded that active involvement of school children in oral health education program with reinforcement of oral health education can improve oral hygiene knowledge, practices and gingival health [55]. A Health education

program for Brazilian public schoolchildren study showed that there was a statistically significant difference between the number of correct answers in the questionnaire after the educational intervention ($P < 0.001$) [54]. Elfaki and her team assessed the impact of health education program on promoting knowledge and practices among school age children in Najran, Saudi Arabia. They found that after the health education program conduction students' knowledge was significantly improved ($p < 0.01$) [56]. The baseline oral health knowledge of the sample was generally poor compared to other studies [56,59,60]. The majority of the sample failed to link gingivitis and gingival bleeding to the needs for dental plaque and calculus removal at dental clinic. This could be attributed to the fact that dental caries is more prevalent in children than periodontal diseases including gingivitis. This is in accordance with a study conducted by Al-Omiri and his where only 13% of the participants thought that dental plaque might cause gingivitis [59]. Relating to the knowledge on the number of permanent teeth, only 24% of the respondents knew the correct number of permanent teeth, this was lower than what was found by Al-Omiri and his colleagues [59]. With regards to the external layer covering the teeth, only one third of the sample gave a correct answer, which may be attributed to the fact that this is specific scientific information that is not included in their regular curricula. However, after the educational program most of the students got to learn this scientific information. About one third of the sample recognized the importance of periodic dental visits. This finding was lower than what was found by previous studies [60,61]. Only 30% of the respondents knew the correct indication for a dentist to do root canal treatment. This could be due to the difficulty for the general population to identify the different types of dental pain and the suitable treatment for each type. However, after the educational program, this question showed the highest level of improvement as the students became aware of the different types of dental pain and their recommended treatment. About half of the participants were unaware of the fluoride role in preventing dental caries. This is in agreement with the finding of Al-Subait who reported that more than half of the participants were unaware about the role of fluoride in dental caries prevention [61].

Also, a study conducted by Elfaki and her colleagues found that most of the respondents had no idea about fluoridated toothpastes [56]. This result however, was much lower than the result obtained by Al-Omiri and his team [59]. The majority of the sample was able to recognize the negative effect of soft drinks and sweets on dental health, as this information can be considered as common knowledge. This is similar to what has been found by a previous study [59]. About two third of the participants were aware of the importance of brushing their teeth at least two times a day for the prevention of dental caries. This was lower than what was found by a study carried out by Amin and Al-Abad where 82% of the sample recognize the importance of teeth brushing to prevent dental caries [60]. Also, it was lower than what was reported by Al-Omiri and his colleagues who found a high level of awareness regarding the importance of the teeth brushing for dental caries prevention [59]. About half of the participants knew correctly the recommended frequency of replacing the tooth brush. This is in agreement with a previous study [60]. Saudi students showed a statistically significant improvement in the level of their oral health knowledge after the program implementation. This might be attributed to their lower level of oral health knowledge before the program implementation. Regarding the students grade, second grade students performed better in the post-intervention questionnaire ($P = 0.004$).

This might be explained by the students' excitement and cooperation. Prior to the educational program implantation, students

from the western region of Riyadh demonstrated the highest level of oral health knowledge among the surveyed students while students from the eastern and southern regions presented with the lowest level of oral health knowledge.

This could be linked to the differences in the socio-economic background of the different regions of Riyadh. After the program implementation, the highest level of improvement in the oral health knowledge was observed in Riyadh's eastern region. This may be associated with the better cooperation of the school's director and supervisors, which facilitated the learning process and provided a good educational environment. In addition, the lower number of students per class played a role since it allowed more time to emphasize the information during the program. The parents' educational level was associated with the oral health knowledge developed by their children. This can be justified by the fact that having parents with higher level of education permitted the acquisition of higher levels of knowledge about healthy daily habits. The limitations of this study were its short-term nature, limitation to schoolgirls only, and although the same oral health information was given to all participants, differences might have occurred due to the dynamic interaction between the health educator and the different student groups. This could have affected the effectiveness of the educational intervention.

Conclusion and Recommendations

This study showed that a school based oral health education program had a positive effect on the student's oral health knowledge. The benefits of such programs can be expanded with continuous school-based oral health programs involving oral health providers, school personals, parents, and their children. Hence, within the limitations of this study, the following are recommendations for structuring school based oral health education programs:

- In addition to the lecture technique, hands-on training in the form of brushing and flossing should be organized in schools to serve as motivational tools for the children.
- Reinforcement of the knowledge is necessary. Incorporating chapters on oral health education in school text books is one way to achieve this.
- Long-term benefits of the improvements obtained need to be confirmed by further studies.
- Educational level of the parents is an important determinant of oral health knowledge among their children, therefore the parents of children could be included in health education programs through the provision of printed oral health educational materials.

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