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Original Article

Dentistry Section

Impact of School-based Online Oral Health Education Programme during COVID-19 Pandemic: A Cross-sectional Study in Riyadh, Saudi Arabia

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ABSTRACT

Introduction: Oral Health (OH) is essential to general health and quality of life. It is affected by the individual's experiences and perceptions.

Aim: To evaluate the effect of online Oral Health Education (OHE) programme on OH knowledge level on school students in Riyadh, Saudi Arabia.

Materials and Methods: This cross-sectional study was conducted virtually on school students in Riyadh city, Saudi Arabia, between February 2021 and May 2021. The sample was based on non probability convenience sampling technique in which 489 students participated in the study. The electronic survey consisted of questions about demographics, school characteristics, and OH knowledge. Online OHE was conducted by dental students of Vision colleges via Zoom and Microsoft teams. Collected data were analysed using using IBM, Statistical Package for the Social Sciences (SPSS) version 20.0, IL, USA. Comparison of differences in the mean knowledge scores across different variables was done using Independent t-test for two means and one-way Analysis of Variance (ANOVA) for more than two means. Linear regression analysis was used to analyse the association between knowledge and other variables in a multivariate environment, and presented by β coefficients and 95% Confidence Interval (95% CI). Significance level was set at p-value <0.05.

Results: Online education had significantly increased the level of knowledge about OH compared to no education (β: 0.46, 95% CI: 0.01, 0.89, p-value=0.04). Students in public schools had significantly higher level of knowledge about OH compared to private schools (β: 0.60, 95% CI: 0.10, 1.11, p-value=0.02). Compared to '1st to 3rd grade', students in 'middle to high grades' had significantly lower knowledge about OH (β:-1.17, 95% CI:-1.87,-0.47, p-value=0.001).

Conclusion: It was concluded that the online health education programme increased the OH knowledge of school students. Students in public schools had higher level about OH compared to private schools' students. Additionally, primary schools' children had higher knowledge than middle and higher schools' children.

Keywords: Coronavirus disease 2019, Distance, Kindergarten, School health promotion

INTRODUCTION

The Oral Health (OH) is an essential part of general health. Growing evidence ascertain the connection between general health and OH [1,2]. Common oral diseases, such as dental caries affect 60-90% of school children worldwide [3]. Now-a-days, communities everywhere are in persistent need for dental public health services to reduce this high level of oral diseases.

Oral Health Education (OHE) was defined as "any educational activity which aims to achieve a health-related goal" [4]. Knowledge is a mixture of comprehension, experience, judgment, and skill. It refers to the persons' ability to gain, retain, and utilise information correctly [5]. It was found that persons with good OH knowledge had better oral care practices [6]. Health education enables people, especially the younger generation, to take more effective control over their own health. Behavioural modification or OHE helps individuals to reduce their OH problems and maintain good OH condition [7]. Health education activities are powerful tools that affect the behavioural characteristics of individuals, such as OH knowledge, attitude, practice, eating habits, dental caries, periodontal diseases, and oral hygiene practice [8].

For many decades children were considered as an important target group for dental health education programmes, and schools were the prime places for these programmes, as about one billion children worldwide spend most of their daytime there [8,9]. Schools are considered good places to deliver OHE in combination with other preventive services to achieve optimum OH [10]. School dental education programmes can be conducted by dental practitioners using several educational aids, such: charts, leaflets, posters, brochures, models, audio-visual aids, and powerpoint presentations [11].

E-learning is a "broad term that includes any use of computers to support learning process, whether online or offline" [12]. E-learning was defined in many ways, one of these definitions is the use of "Internet technologies to deliver a broad array of solutions that enhance knowledge and performance" [13].

Due to Coronavirus disease 2019 (COVID-19) lockdown, the world's view of education has been changed to replace the old teaching methods by newer ones. In the Kingdom of Saudi Arabia, several schools' health education programmes were conducted physically [9,14]. However, there was no online OHE programmes performed there. To our best knowledge, this study is the first of its kind in the Kingdom of Saudi Arabia and Arab countries, which used an online OHE programme. Hence, aim of the study was to evaluate the effect of online OHE programmes on OH knowledge level among the school students in Riyadh, Saudi Arabia during COVID-19 pandemic.

MATERIALS AND METHODS

This cross-sectional study was conducted in Riyadh city, Saudi Arabia between February 2021 and May 2021. Approval was obtained from Ethical Committee at Vision colleges in Riyadh city (visi.dent-2021021). As a result of COVID-19 pandemic, the ministries of health and education restricted physical attendance of students to

the schools during the previously specified period. Therefore, the programme was conducted online via Zoom and Microsoft teams.

Inclusion criteria: Kindergarten children, and students from '1st to 3rd grade', '4th to 6th grade', and 'middle to high grades' who accepted the participation via the activity links were included in the study.

Exclusion criteria: Students who did not accept participation or their families refused their participation were excluded from the study.

Sampling technique and sample size calculation: The sample was based on non probability convenience sampling technique, where schools and students of different grades who agreed and wished to participate were in the study. The required sample size for each group was 199 students which was estimated from the following inputs; two independent groups, with an effect size 0.25 at 5% significance level, and 80% power effect [15]. A total of 489 students participated in the present study.

Preparation for the Study

Graduating dental students of Vision colleges in Riyadh city were assigned to conduct their community services among school's students, and then the students were divided into nearly equal groups (four students each). By the help of the course coordinator of community dentistry and the college's administrators, the dental students arranged randomly with about 11 public and private schools to implement their programmes.

The programme approvals were obtained from the college and sent by mails to the school Principals. School Principals gave their approval and arranged suitable times for the dental students to conduct their programmes. The school's administrators sent messages to the children through their social media communication channels to inform them about the time and the programmes links on (Zoom or Microsoft teams). Then students who wished to participate attended our educational programme at the specified time.

Programme activities: The programme activities were offered to all participants, and started by a short animation video about the importance of OH to make the students more attentive during the activity. Then, lectures in the form of powerpoint presentations were given. At the end, two short videos (one about tooth flossing and the other about tooth brushing) were shown to the students. Finally, some interactive prepared questions about OH knowledge from the given lectures were discussed with the students.

Questionnaire

The student's knowledge level was assessed by self-administered online questionnaire consisting of 17 close-ended questions which was created on Google forms. The students were assigned into two groups to assess the effect of the educational programme: no OHE group (n=288) who filled the questionnaire before the online education programme, and online OHE group (n=201) who filled the questionnaire after the educational programme. In other words, some students filled the questionnaire without receiving the educational programme (no OH education), while others filled it after the educational programme (online OH education).

The questionnaire comprised of two main sections:

1) Demographics and school characteristics, and
2) OH knowledge.

The first section included questions about gender, school type, and schooling grade. Schools were either private or public, and grades were grouped into: 'kindergarten', '1st to 3rd grade', '4th to 6th grade', and 'middle to high grades'. OH knowledge was assessed using 14 multiple choices questions which covered basic information about OH, oral hygiene practice, and certain habits that affect the teeth. The knowledge questions included the number of permanent and primary teeth, foods and drinks that affect the teeth, frequency and duration of teeth brushing, the recommended type of tooth brush, frequency of its replacement, direction of tooth brushing, fluoride and the recommended frequency of dental visits. The questionnaire was obtained from previously published works after obtaining authors' permission [14,16,17]. Survey questions were pretested in previous studies [14,16]. Then, our questionnaire was also pretested on a sample of school students after Arabic translation of some questions. For kindergarten students, educators read and explained the questions. In addition, questionnaire for this group was supplemented by figures to help in improving their comprehension. Knowledge score was calculated as the number of correct questions out of the 14 knowledge questions [Annexure -1].

STATISTICAL ANALYSIS

Student's responses were saved in spreadsheets and downloaded from Google forms, then these data were analysed using IBM, SPSS version 20.0, IL, USA. The level of significance was set at p-value <0.05. Descriptive analysis was conducted using frequency with percentage for nominal variables and mean with standard deviation for continuous variables. Differences in mean knowledge scores across different variables were done using Independent t-test for two means and one-way Analysis of Variance (ANOVA) to compare between more than two means. Linear regression analysis was used to analyse the association between knowledge and other variables in a multivariate environment and presented by β coefficients and 95% CI.

RESULTS

Out of 636 students, a total of 489 students within age 5 to 18 years participated in this study with a response rate of 76.9%. Gender was equally distributed in the selected sample with 254 (51.94%) girls and 235 (48.06%) boys. About 60.33% (n=295) of the participants were from private schools while 39.67% (n=194) from public schools. For grades distribution, the highest number of participants was in '1st to 3rd grade' (n=194, 39.67%), followed by 'middle to high grades' and '4th to 6th grade' (n=180, 36.81% and n=98, 20.04%, respectively), and least was among 'kindergarten' (n=17, 3.48%).

About 58.89% (n=288) did not receive online OHE, and 41.10% (n=201) received the online OHE. The knowledge about OH score ranged between 2 and 14 with mean of 8.75±2.18. When compared by OHE [Table/Fig-1], significantly higher percentage of girls received online education compared to boys (58.66% and 22.13%, respectively; p-value <0.0001). In addition, significantly higher percentage of 'middle to high grades' students received the online education (70%) compared to '1st to 3rd grade' (19.07%) and '4th to 6th grade' (33.67%) at p-value <0.0001. Significantly lower percentage of students from private schools received online education compared to public schools (25.76% and 64.43%, respectively; p-value <0.0001).

Variables	No oral health education (n, %)	Online oral health education (n, %)	p-value	Total (n, %)
Gender				
Boys	183 (77.87)	52 (22.13)	**<0.0001**	235 (48.06)
Girls	105 (41.34)	149 (58.66)		254 (51.94)
Grade				
Kindergarten	12 (70.59)	5 (29.41)	**<0.0001**	17 (3.48)
1st to 3rd grade	157 (80.93)	37 (19.07)		194 (39.67)
4th to 6th grade	65 (66.33)	33 (33.67)		98 (20.04)
Middle to high grades	54 (30)	126 (70)		180 (36.81)
School type				
Private	219 (74.24)	76 (25.76)	**<0.0001**	295 (60.33)
Public	69 (35.57)	125 (64.43)		194 (39.67)

[Table/Fig-1]: Distribution of sample participants across oral health (OH) education groups (N=489).
p-value <0.05,Chi-square test used

The mean score for OH knowledge across variables of interest is presented in [Table/Fig-2]. There was no statistically significant difference in knowledge between who received online education (8.83±2.36) and who did not (8.69±2.04). However, when this difference was stratified by gender, girls had significantly lower knowledge (8.63±2.37) compared to boys (9.38±2.27) among who received online OHE at p-value=0.04. There was no statistically significant difference among students who received online education by grade. Among online OH education, students from public schools scored significantly higher knowledge about OH compared to private schools (9.15±2.15 and 8.29±2.60, respectively) at p-value=0.01.

Online oral health education	Oral health knowledge (mean±SD)		p-value
	No oral health education	Online oral health education	
Total Score	8.69±2.04	8.83±2.36	0.52
Gender			
Boys	8.97±1.99[a]	9.38±2.27[b]	0.20
Girls	8.22±2.05[a]	8.63±2.37[b]	0.15
School grade			
Kindergarten	8.17±1.80	7.80±1.79	0.71
1st to 3rd grade	8.95±1.93[c*]	9.22±2.64	0.56
4th to 6th grade	8.92±2.12[c**]	9.64±1.82	0.10
Middle to high grades	7.81±2.08[c*,c**]	8.54±2.37	0.04*
Type of school			
Private	8.82±1.95	8.29±2.60 d	0.10
Public	8.30±2.27	9.15±2.15 d	0.04*

[Table/Fig-2]: Differences in mean knowledge about oral health across different variables presented by mean and standard deviation (SD).
*p-value for difference between education categories using Independent t-test.
[a-d] significant difference between similar superscript letters among the education category;
a means p-value=0.002, b means p-value=0.04, c* means p-value=0.002, c** means p-value=0.017, d means p-value=0.01
[a,b,d]Independent t-test, [c]one-way ANOVA

The relationship between OH knowledge and other variables was further assessed in a multivariate model [Table/Fig-3]. The online education group had significantly higher level of knowledge about OH compared to no education (β coefficient 0.46, 95% CI: 0.01, 0.89, p-value=0.04) after accounting for other related variables in the model. Students in public schools had significantly higher level of knowledge about OH compared to private schools (β coefficient 0.60, 95% CI: 0.10, 1.11, p-value=0.02). Compared to '1st to 3rd grade', students in 'middle to high grades' had significantly lower knowledge about OH (β coefficient -1.17, 95% CI: -1.87, -0.47, p-value=0.001) when other variables in the model were held constant.

Predictors	β coefficient	p-value	95% Confidence interval	
			Lower	Upper
Online education				
No oral health education	Reference			
Online oral health education	0.46	0.04	0.01	0.89
Gender				
Boys	Reference			
Girls	-0.19	0.49	-0.73	0.35
School type				
Private	Reference			
Public	0.60	0.02	0.10	1.11
Grade				
1st to 3rd grade	Reference			
Kindergarten	-0.92	0.09	-1.99	0.16
4th to 6th grade	-0.18	0.54	-0.74	0.39
Middle to high grades	-1.17	0.001	-1.87	-0.47

[Table/Fig-3]: Linear regression for oral health knowledge among a sample of school students in Riyadh, Saudi Arabia (N=489).

DISCUSSION

Schools' dental health education programme is one of the easiest and cheapest OH promotion methods. OHE is the first level of the four levels of OH promotion intervention evaluation methods as reported by Nutbeam D [18]. It was mentioned before that individuals' behaviour can be changed by exposure to health educational messages [19]. Several studies cleared the roles of OHE programmes and their effect on OH behaviour and attitude, especially for the primary school children which can be temporary improved irrespective of the educational method followed [20-23].

According to our findings, online OH education was associated with higher mean knowledge score in comparison to no OH education (β: 0.46, 95%CI: 0.01, 0.89, p-value=0.04). This finding was supported by multiple previous studies [24-26]. For example, D'Cruz AM and Aradhya S reported significant improvements in OH knowledge at different intervals among the experimental group who received OHE (change at 3 months: 58.61%, at 6 months: 105.91%, and at 9 months: 123.39%; p-value <0.001) [24]. In addition, the present study results were in line with Swe KK et al., who reported that active participation of school children in repeated OHE programmes can improve their oral hygiene knowledge (percent change of intervention group at 1 year: 54.69%, and at 1.5 years: 66.12%; p-value <0.001) [25]. Moreover, a study in Indonesia assessing the effect of school-based OHE programme showed a moderate positive effect on students' OH knowledge [26]. The improvement in OH knowledge is expected to lead to an enhancement in OH measures, which was supported by Hart E and Behr M who demonstrated that continual OHE programmes effectively maintained OH behaviour and regular dental check-ups [27].

A study was conducted in Pakistan and cleared that one-time teacher-centred OHE was insufficient to improve OH knowledge, behaviour, and oral hygiene status of school students when compared to repeated and reinforced programmes [28]. This could partially explain our slight improvement in knowledge level between the two study groups (8.69 and 8.83, for no OH education and OH education groups, respectively). Ideally, schools OHE programmes should be repeated over a period to enhance the students' health knowledge and behaviour as concluded from several studies [23,24]. Another point to clear here is the nature of our online programme with some technical problems like internet connection or interruption from participated young children. The present study findings emphasise also that online education is less effective than physical education for these age groups.

In the present study, the mean knowledge score of girls who received the OHE was significantly lower than boys (8.63±2.37 and 9.38±2.27, respectively; p-value=0.04). However, the multivariate analysis revealed insignificant difference in OH knowledge across gender. This finding was contradicted by Al Saffan AD et al., as they found that non Saudi females showed significantly higher mean knowledge at post-test assessment and explained their results by the higher interest in self-care and appearance of females than in males [9].

The findings of the present study revealed statistically significant difference in the knowledge score between students who received and did not receive OHE in the public schools. The mean knowledge score among those who received OH education in the public schools was also higher than that in the private schools (9.15±2.15 and 8.29±2.60, respectively; p-value=0.01). Public schools are more targeted by health education programmes conducted by dental schools or medical centres, as often students in public schools comes from lower socio-economic level compared to private schools. Thus, students in public schools are frequently exposed to OHE programmes and this explains their higher knowledge level than their counterparts.In the online OHE group, there were generally higher mean knowledge scores in all school grades compared to no education, except among kindergartens group. The present study

Author's name and year of publication	Place of study	Number of subjects	Age of subjects	Parameters assessed	Conclusion
Hart E and Behr M (1980) [27]	New York, United States of America	134	12 year-old	The effectiveness of school-based OHE programme that was combined by parental support component.	The continual oral health education programmes effectively maintained oral health behaviour, attitudes, and knowledge.
Hartono WA et al., (2002) [26]	West Java, Indonesia	140	8 to 12-year-old	The effect of school-based OHE programme in terms of visible plaque, oral hygiene skills, caries experience, oral health knowledge and behaviour.	The programme had a moderate positive effect on oral cleanliness, tooth brushing skills, and on oral health knowledge of the school children.
D'Cruz AM and Aradhya S (2013) [24]	Bangalore city, India	568	13 to 15-year-old	The effect of OHE programme on oral hygiene knowledge, practice, plaque control and gingival health.	OHE programme can improve oral hygiene knowledge, oral hygiene practices, gingival index, and plaque index levels.
Haque SE et al., (2016) [32]	Bangladesh	944	Adolescent from grades 6 to 8	The impact of school-based OHE programme in increasing knowledge, attitude, and practice regarding oral hygiene.	OHE was effective in increasing knowledge, attitude, and practice toward oral health.
Pradhan D et al., (2020) [33]	Kanpur city, India	876	13 to 15-year-old	The impact of OHE on the knowledge, attitude, and practice of the target population.	OHE was effective in improving the oral health knowledge, attitude, and practice of school children.
Swe KK et al., (2021) [25]	Magway Region, Myanmar	220	8 to 12-year-old	The role of OHE on oral health knowledge and behaviour.	Repeated OHE was effective in promoting and sustaining oral health knowledge and behaviour.
Elfaki N et al., (2015) [34]	Najran, Saudi Arabia	288	10 to 13-year-old	The impact of health education programme on oral health knowledge and practice of school children towards dental caries.	OHE improved the students' awareness of the importance of maintaining oral health, and the role of fluoridated toothpaste in combating dental caries.
Al Saffan AD et al., (2017) [9]	Riyadh, Saudi Arabia	1279	8 to 15-year-old	The effect of OHE on oral health knowledge of primary and intermediate school students in private schools.	Oral health knowledge was improved immediately after educational intervention among primary and intermediate private school students.
Alotaibi AS et al., (2016) [35]	Riyadh, Saudi Arabia	315	12 to 16-year-old girls	The impact of oral health education programme on the oral health knowledge of public females intermediate school students.	The school based oral health education programme had a positive effect on the students' oral health knowledge.
Halawany HS et al., (2018) [14]	Riyadh, Saudi Arabia	1661	6 to 8-year-old girls	The effectiveness of OHE programme on knowledge and self-reported oral health behaviour.	There was a significant improvement in the knowledge and self-reported oral health behaviour.
Present study (2022)	Riyadh, Saudi Arabia	489	Students from kindergartens to high schools	The effect of online OHE programme on oral health knowledge.	The online health education programme improved the oral health knowledge of school students.

[Table/Fig-4]: Some of International and national studies that assessed the effect of Oral Health Education (OHE) on school children.

finding matched with Halawany HS et al., who reported significant improvement in knowledge scores among their students from the 1st grade to the 3rd grades [14]. Also, Hartono WA et al., revealed moderate improvement in the knowledge score among 8 to 12-year-old children [26]. In addition, Sriarj W et al., reported an improvement among 3rd grade students after three follow-up months of their OHE programme [29].

Young children in kindergarten, due to parental involvement, are usually highly interactive and interested [30]. However, there are several factors that may lead to the lack of difference in OH knowledge among kindergarten. First, their number in our sample was too small to make judgement; second, their limited ability to read without assistance could probably influence their ability to fill the questionnaire; third, the attention span using the online teaching for this age group is limited [31]. Comparison of the findings of this study with previous studies has been done in [Table/Fig-4] [9,14,24-27,32-35].

Limitation(s)

The present study has some limitations. The use of non random sample may affect the generalisability of the findings. In addition, future studies are recommended to use self-control (pre and post education) to clarify the effectiveness of online OH education after controlling for other factors related to OH knowledge, such as socio-economic status and parental education. The introduction of online OHE programmes was accompanied by technical issues related to the internet connection. Such unavoidable problem could have limited the effectiveness of the OHE programme.

CONCLUSION(S)

Online health education programme improved the OH knowledge of school children. Students in public schools had higher knowledge level about OH compared to private schools' students. Surprisingly, primary schools' children had higher knowledge than middle and higher schools' children. Within this study's limitations, online health education can be considered as a useful tool for increasing OH knowledge for most of school students during the pandemic.

It is recommended to conduct longitudinal follow-up studies utilising a representative sample to improve the generalisability of study results. For kindergartens' children, parents should be involved in OHE programmes to enhance children's attention engagement.

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ANNEXURE-1

Section A- Demographic profile and school characteristics

Section B- Oral health related questions

1. How many are the deciduous teeth?
a. 12
b. 20
c. 32

2. How many are the permanent teeth?
a. 12
b. 22
c. 32

3. Caries can result from?
a. Germs
b. Improper brushing of the teeth
c. Sweets
d. It happens for no reason

4. Any drink that does not harm my teeth?
a. Water and milk
b. Coffee
c. Soft drinks

5. Which food is good for my teeth?
a. Vegetables and Fruits
b. Chocolate
c. Sweets

6. How many times should I visit the dentist in a year?
a. Once a year twice a year
b. When my teeth hurt

7. How many times should I brush and paste my teeth per day?
a. Once a day
b. Twice a day
c. Three times a day
d. After all meals

8. What is the appropriate time to brush teeth?
a. In the morning before breakfast and before bedtime
b. In the morning after breakfast
c. After eating lunch
d. In the morning before breakfast, noon after lunch, and right before bedtime
e. Any time of the day

9. What is the preferred type of toothbrush?
a. Hard bristled brush
b. Soft bristled brush
c. Medium bristle brush
d. I do not know

10. The duration of dental cleaning should be
a. 2 minutes
b. 15 minutes
c. 60 minutes

11. When should I replace my used toothbrush?
a. After 1 month of use
b. After 3 months of use
c. After 6 months of use
d. When it wears

12. A substance in toothpaste that helps the teeth to be strong against cavities
a. Sugar
b. Mint
c. Fluoride

13. The amount of toothpaste used
a. The brush should be completely covered
b. It should cover half of the brush
c. It should be the size of a pea
d. I do not know

14. What is the appropriate direction of movement for the brush while brushing?
a. Circular
b. Vertical
c. Horizontal
d. I do not know