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Comparing the effects of online versus Face-to-face oral health education sessions in primary school children in Egypt: A randomized controlled trial

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Aim: This study aimed to compare the effect of online oral health education (OHE) to the face-to-face OHE method on oral health knowledge and oral hygiene self-reported practice of school children.
Materials and methods: Using a randomized controlled trial design, 624 students from two national private schools in Egypt were included in the study. They were equally allocated to both study groups. The first group received online oral health education and the second group received face-to-face oral health education sessions and data was collected using a validated modified questionnaire. Knowledge and practice levels were scored and compared on pre- and post-intervention levels. Categorical data was analyzed using Chi-square test, while ordinal data was analyzed using Mann-Whitney U test.
Results: Face-to-face oral health sessions showed statistically significant improved results regarding the knowledge and practice levels of primary school children in comparison to the online oral health education session. The regression analysis model showed that participants receiving online oral health education had significantly higher odds of having insufficient knowledge in comparison to the face-to-face method ($p<0.001$), regardless of gender and school stage ($p>0.05$).
Conclusion: Face-to-face oral health education is a more effective method in improving oral health knowledge and practice in comparison to the Online method, which calls for further exploration of online health education methods.

Keywords: Oral health; Oral health education; Primary school children; E-health

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Introduction

Dental caries is a highly prevalent disease affecting children globally, with an estimated 0.5 billion cases in 2019 among those aged 0-14.[1] This disease causes various adverse outcomes, including pain, infections, tooth loss, and reduced function.[2,3]

In Egypt, a survey conducted in collaboration with the WHO revealed that approximately 70% of children have dental caries and 80% suffer from periodontal disease.[4]

Factors such as dietary habits, socioeconomic status, parental education level, and brushing frequency significantly impact the prevalence of dental caries among Egyptian children.[5] The school canteen contributes to poor oral health by providing high-energy, low-nutrition food which also exacerbates the issue.[6]

Overall oral health is linked to general health, with poor oral conditions serving as predictors for future cardiovascular issues.[7] Dental problems can also lead to school absenteeism, lower academic performance, reduced quality of life for affected children and their families, and financial burdens.[3] Children with poor oral health are significantly more likely to miss school compared to their healthier peers.[8]

Dental problems have increased in the past era in low-middle-income countries due to increased consumption of free sugars, inadequate exposure to fluoride, and lack of public health measures, which highlights the need for oral health promotion programs.[3,9]

In 1995, The WHO Global School Health Initiative was established and is based on the principles of the Ottawa Charter which emphasized the importance of School Health Education and Promotion.[10,11] One major part of school health promotion is school health programs[12], which are crucial in addressing risk factors such as non-communicable diseases and unhealthy eating by integrating face-to-face health education with policies fostering supportive environments.[13]

Oral health education (OHE) school programs were mostly implemented in a face-to-face way where recipients received oral health knowledge while in direct contact with the educator.[14] Given the shift towards online education following the COVID-19 outbreak, particularly in Egypt, the study aims to evaluate whether incorporating online Oral Health Education (OHE) programs into children's educational routines can enhance their oral health (OH) knowledge and practices.

According to a study conducted on high school students, E-health literacy had a great impact on the health behaviors of the participants, which shows that technology can be utilized using E-health and online health education methods to help promote health in school children.[15]

The literature highlights a significant gap in the field of oral health education, particularly among school children in Egypt. It notes that while there is a wide array of studies on different methods of oral health education globally, similar research focusing on Egyptian schoolchildren is limited. The scarcity of research involves the usage of online methods to deliver oral health education and shows the need for more investigations into the efficacy and implementation of online health education methods in Egypt.

This study aimed to compare the effect of online OHE to the face-to-face OHE method on oral health knowledge and oral hygiene self-reported practice of school children. The null hypothesis of the study proposed that there were no differences between both methods.

This study aims to provide a steppingstone towards further studies that involve more innovative methods in delivering health knowledge to school children in Egypt.

Materials and methods

Study design and population

The study was conducted on two private schools in Cairo, Egypt, during the academic year 2022-2023 after obtaining official approval from both school boards. Two-parallel arms randomized controlled trial study design was used. The selected schools were two national private schools (Futures Language Schools, Al-Sherook branch, and Futures Language Schools Othman ibn Affan branch). The study involved participants of both genders who were in the 3rd and 4th primary school grades. The age range of these participants was between 7 and 9 years old. There were 8 classes in each school grade, of a total of 32 classes for both schools. In each school grade, the classes were dealt with as clusters and were equally and randomly assigned to the study groups. For example, 4 random classes were assigned to the face-to-face group while the other remaining 4 were assigned to the online group for both the 3rd and 4th primary school grades in both schools.

Participants who were currently residing in Egypt were eligible to be included in the study. Those who did not consent to participate in the study, participants who received previous oral health education, and non-Egyptians were excluded from the study.

Sample size

The sample size was calculated using G*Power software version 3.1.9.4 for MS Windows, Franz Faul, Kiel University, Germany. The sample size assumption was based on testing the change in KAP before and after each educational intervention.[16] The predicted sample size was found to be 265 children for each oral health educational method (power = 90%). After adding a 15% increase to adjust for excluded data, the final sample size was 305 children for each educational method, a total of 610 children.

Study procedures

Study settings and recruitment

Initially, 10 schools were selected for the OHE program. Five of them were excluded from the study since they had received previous OHE sessions, which might have affected the results of this study. The two schools included in this study were randomly selected from the remaining 5 schools using the random sequence generator (Figure 1). The main researcher approached the two schools' educational boards for the agreement to conduct the study on their premises. Participants were recruited in November 2022 through WhatsApp notifications and official school channels. In the Al-Sherook branch, 311 eligible participants were recruited, while in the Othman Ibn-Affan branch, 313 eligible participants were recruited.

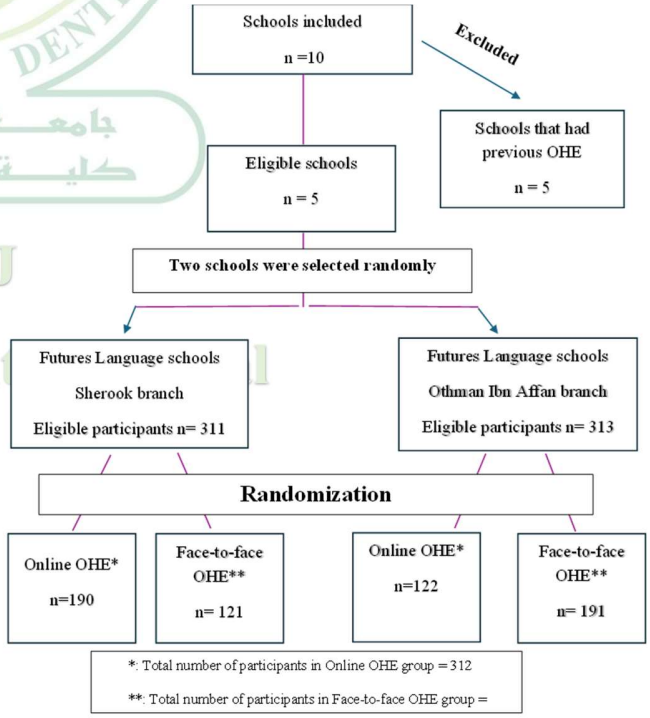

Figure 1: Flowchart showing allocation of schools and participants included in the study

Study instrument

A predesigned English, validated questionnaire was selected for the current study [17] and modified according to a pilot study that was conducted in a separate school. The pilot study followed the same design, recruitment criteria, and methods as the main study, and aimed to assess the participants' ability to comprehend the questionnaire.

Some modifications were made to improve the clarity of the questionnaire. For example, question one in the original questionnaire was "How often do you brush your teeth?" and was changed to "How many times do you brush your teeth?" to better address the age groups involved in the study.

The modified questionnaire was applied pre- and post-intervention for both study groups and was administered in the English language. The study participants were in language schools that provided English language as their first language to their students, which made it easier for them to comprehend the modified questionnaire without the need for translating it. The post-intervention questionnaires were conducted one week after the educational sessions to assess the short-term effectiveness of the educational methods.

The modified questionnaire was divided into two sections, section 1 (Knowledge assessing questions) and section 2 (Practice assessing questions)

Study Outcome Variables

The study measured two outcomes, namely the knowledge and practice levels of the participants.

The knowledge-assessing questions aimed to assess the general oral health knowledge of the participants and comprised a total of four questions that asked about the meaning of dental plaque, what it leads to, the causes of gum bleeding, and how to protect our gums. Three of the questions were single-answer questions and one question with multiple correct answers. Single-answer questions were given 1 mark each. For the question with multiple correct answers, 1 mark was assigned for each correct answer. The maximum possible score in the knowledge section was 5 marks: 3 marks for the single-answer questions and 2 potential marks for the multiple-answer questions. Knowledge scores for each participant were considered to be sufficient if the total correct answers were above 50% (3 out of 5 marks).[18,19]

The practice assessing questions in the study focused on how the participants brushed their teeth, the frequency of tooth brushing, the timing of toothbrushing in the day, and the tools used to care for their oral health. There were 4 questions in total, divided into 3 single-answer questions and 1 multiple-choice question. Practice questions were scored by frequency and percentage of answers and comparing their pre- and post-intervention percentage values.

Study Procedures

The main investigator explained the study procedures to the participants of each study group before the implementation of the intervention. The next step involved distributing the self-reported questionnaire to the participants. Participants were instructed to answer the questionnaire without help from their peers to avoid response bias. The questionnaires were answered in the classrooms for both study groups under the supervision of the main investigator. After collecting the pre-intervention questionnaires, the main investigator proceeded to initiate the health education session according to the study group. Participants in the face-to-face OHE group received their educational sessions in their classrooms in the form of a presentation created using Prezi™ software to ensure the participants' engagement using flashy graphics and interactive activities. For the

Online OHE group, the participants did not receive any educational intervention in their classrooms and were instructed to log in to their Microsoft Teams ™ accounts and WhatsApp ™ groups to access the presentation from their home computers. The online sessions were accessible to the assigned group at all times for the duration of the study (one week) whenever the participants logged into their Microsoft Teams or WhatsApp accounts. The participants in the online OHE group received personal notifications to remind them of the online OHE session sent to them. Participants of both groups received their educational material on the same day to limit any possible contamination between the study groups.

The educational session lasted an average of 20-30 minutes per classroom. The language used for the oral hygiene instructions for both methods was a mixture of Arabic and English language where the English language was used to convey scientific terms and the Arabic language was used to facilitate the participants' understanding. Educational material was presented using the English language. Participants of both groups were assessed after one week using the post-intervention questionnaire.

The educational material in the presentation included:

- Defining habits and how toothbrushing is considered an important habit,
- The definition of dental caries and bacteria,
- The adverse outcomes of dental caries on primary teeth with pictures showing teeth before and after caries for psychological impact,
- The importance of healthy food, types of sugars, and which sugars are the least cariogenic,
- Fones Circular Toothbrushing Technique and different instruments used to maintain good oral hygiene,
- Cartoon animations that explain the tooth decay process.

The educational materials used in the sessions followed a dental curriculum created by the American Dental Association (ADA) called "Smile Smarts Dental Health Curriculum" available on mouthhealthy.org.[20]

A printed educational booklet written in Arabic language was distributed for both schools to be easily accessible to the teachers. These booklets involved OHE material suitable for adults and their children. The purpose of distributing these booklets was to ensure that the participants of the study were involved in a healthy and educational environment while increasing OH awareness in the community.

Allocation and Randomization

The total participant number was 624. Participants in both schools were equally allocated into both study arms (face-to-face and online OHE groups) with an allocation ratio of 1:1 as shown in Figure (1).

For the randomization procedure, the main investigator allocated the participants to both study arms using a computerized random sequence generator, where the type of randomization was simple randomization. Participants who were not eligible for the study were excluded from the study before the randomization procedure. Participants were blinded to which group they were allocated to before applying the study interventions. There was no loss of eligible participants after the randomization procedure.

No loss to follow-up among participants was reported.

Blinding

Participant blinding: The participants were blinded to which study arm they were assigned to but could not be blinded from the type of intervention (online or face-to-face) since they were informed of the nature of the intervention before conducting it in their classrooms.

The main investigator: Could not be blinded due to different types of interventions used which were known to the investigator before the study.

The statistician: Was blinded through a coding system that was performed by the main investigator. Schools and classes were given codes that were only known to the main investigator and the statistician was blinded from the data received before the statistical analysis.

Statistical analysis

Categorical data for the practice section were presented as frequencies and percentages and were analyzed using the chi-square test for intergroup comparisons, and the marginal homogeneity test for intragroup comparisons. Pairwise comparisons were done using multiple z-tests with Bonferroni correction. Ordinal data were presented as mean and standard deviation values. They were analyzed using the Mann-Whitney U test and signed rank tests for inter and intragroup comparisons respectively. The effect of multiple variables on knowledge was analyzed using multiple binomial logistic regression. The significance level was set at $p<0.05$ for all tests. Statistical analysis was performed with R statistical analysis software version 4.3.1 for Windows.[21]

Ethical considerations

An informed consent has been obtained from all the subjects and their legal guardians through an online message that was sent to the participant's caregivers explaining the educational sessions in detail and those who did not want their children to be included have sent their refusal to the school board. Verbal approval was obtained from the children included in the study before conducting it in the classrooms.

Participants who opted out of the study and those who were excluded from the study still received oral health education sessions, but their data were not included in the data analysis. All the participants' data obtained was protected and their anonymity was maintained.

Results

The study included a total of 624 students from two different branches of Futures Language School, with 311 (49.8%) from the Sherook branch and 313 (50.2%) from the Othman Ibn Affan branch. The participants were in the age group of 7-9 years old, with a mean age of 8. They were equally divided into face-to-face and online OHE groups, each comprising 50% of the participants. Among the male participants, 147 (47.1%) were in the face-to-face OHE group and 150 (48.1%) were in the online OHE group. For female participants, 165 (52.9%) were in the face-to-face OHE group and 162 (51.9%) were in the online OHE group. Frequency and percentage values for demographic data are presented in Table (1). The reported response rate was 100% for both study groups for the pre- and post- intervention questionnaires.

Table (2) shows the effect of the OHE session on knowledge scores. For the face-to-face method, pre-intervention mean scores were 0.39±0.74 in comparison to the post-intervention mean scores of 2.71±1.53 with a significant p-value (<0.001). For the online method, pre-intervention mean scores were 0.77±1.19 in comparison to the post-intervention mean scores of 0.81±1.16 with a non-significant p-value (0.360ns).

Table 1: Frequency and percentage values for demographic data for study participants (n=624)

Parameter			Face-to-face method	Online method
Gender	Male	n	147	150
		%	47.1%	48.1%
	Female	n	165	162
		%	52.9%	51.9%
School	Futures sherook branch	n	121	190
		%	38.8%	60.9%
	Futures Othman ibn-Affan branch	n	191	122
		%	61.2%	39.1%
Grade	Third grade	n	115	172
		%	36.9%	55.1%
	Fourth grade	n	197	140
		%	63.1%	44.9%

Table 2: Effect of the oral health education session on knowledge scores for the study participants in both study groups (n=624).

Learning method	Measurement	Knowledge score		p-value
		Pre-intervention	Post-intervention	
Face-to-face method	Mean±SD	0.39±0.74	2.71±1.53	<0.001*
	Median (IQR)	0.00 (1.00)	3.00 (2.25)	
Online method	Mean±SD	0.77±1.19	0.81±1.16	0.360ns
	Median (IQR)	0.00 (1.00)	0.00 (1.00)	

*; significant (p < 0.05) ns; non-significant (p>0.05)

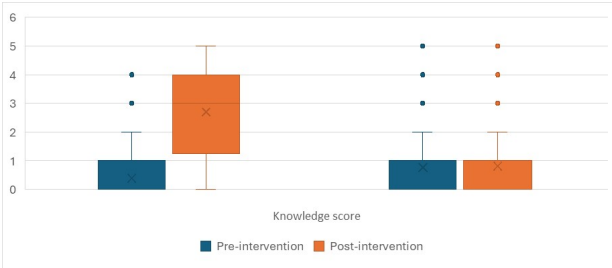

Figure 2: Box plot showing values for knowledge score pre-and post-intervention for study participants in both study groups (n=624)

A median IQR score for the post-intervention face-to-face OHE group was [3.00 (2.25)] in comparison to the online OHE group [1.00 (1.00)]. This data shows a significant improvement in participants' knowledge levels when receiving face-to-face OH education, while participants receiving online OH education show non-significant results post-intervention as illustrated in Figure (2).

Table (3) shows the effect of the OHE education session on the practice scores of the face-to-face group. For the question "How many times do you brush your teeth?", a significantly higher number of participants (39.10%) chose "Two times" post-intervention in comparison to the pre-intervention scores (29.17%) and a significantly lower percentage (8.65%) chose "Sometimes" post-intervention in comparison to the pre-intervention scores (16.99%) with (p=0.008). For other questions, the effect of the OHE sessions was not statistically significant (p>0.05).

Table (4) shows that the effect of the OHE education session on the practice scores of the online group was not statistically significant when comparing the results of the pre-intervention to the post-intervention questionnaire.

Regression analysis

A multiple logistic regression model was built to predict knowledge level (sufficient/insufficient) from learning method, gender, and school grade. The overall model was statistically significant (p<0.001) and predicted 8.5% (Nagelkerke R^2) of the variability in knowledge level. Results showed that participants receiving online OHE have significantly higher odds of having insufficient knowledge in comparison to the face-to-face method (p<0.001), regardless of gender and school stage (p>0.05). Regression analysis is presented in Table (5).

Table 3: Effect of the OHE session on practice questions for participants in the face-to-face method group (N=312)

Question	Answer	Pre-intervention	Post-intervention	p-value
How many times do you brush your teeth? (n=624)	1. One time.	40 (12.82%)^{A}	45 (14.42%)^{A}	0.008*
	2. Two times.	91 (29.17%)^{A}	122 (39.10%)^{B}	
	3. Three times or more.	102 (32.69%)^{A}	102 (32.69%)^{A}	
	4. Sometimes.	53 (16.99%)^{A}	27 (8.65%)^{B}	
	5. I forget to brush sometimes.	19 (6.09%)^{A}	12 (3.85%)^{A}	
	6. I don't brush my teeth.	7 (2.24%)^{A}	4 (1.28%)^{A}	
What do you use for cleaning your teeth? (n=899)	1. Brush + toothpaste.	294 (64.90%)^{A}	301 (67.49%)^{A}	0.750ns
	2. Dental floss.	26 (5.74%)^{A}	29 (6.50%)^{A}	
	3. Mouthwash.	73 (16.11%)^{A}	69 (15.47%)^{A}	
	4. Toothpicks.	51 (11.26%)^{A}	41 (9.19%)^{A}	
	5. I don't brush my teeth.	8 (1.77%)^{A}	6 (1.35%)^{A}	
	6. I do not know.	1 (0.22%)^{A}	0 (0.00%)^{A}	
When do you brush your teeth? (n=624)	1. Morning.	44 (14.10%)^{A}	40 (12.82%)^{A}	0.474ns
	2. Noon (after lunch).	6 (1.92%)^{A}	12 (3.85%)^{A}	
	3. Before going to bed.	32 (10.26%)^{A}	25 (8.01%)^{A}	
	4. At morning and before going to bed.	137 (43.91%)^{A}	131 (41.99%)^{A}	
	5. At morning, after lunch and before going to bed.	80 (25.64%)^{A}	94 (30.13%)^{A}	
	6. I don't brush my teeth.	9 (2.88%)^{A}	5 (1.60%)^{A}	
	7. I do not know.	4 (1.28%)^{A}	5 (1.60%)^{A}	
How long do you brush your teeth? (n=624)	1. Less than one minute.	27 (8.65%)^{A}	23 (7.37%)^{A}	0.369ns
	2. One minute.	67 (21.47%)^{A}	66 (21.15%)^{A}	
	3. Two minutes.	68 (21.79%)^{A}	85 (27.24%)^{A}	
	4. More than two minutes.	97 (31.09%)^{A}	77 (24.68%)^{A}	
	5. I don't brush my teeth.	8 (2.56%)^{A}	7 (2.24%)^{A}	
	6. I don't know.	45 (14.42%)^{A}	54 (17.31%)^{A}	

Values with different superscript letters within the same horizontal row are significantly different *; significant (p < 0.05) ns; non-significant (p>0.05)

Table 4: Effect of the OHE session on practice questions for participants in the online method group (N=312)

Question	Answer	Pre-intervention	Post-intervention	p-value
How many times do you brush your teeth? (n=624)	1. One time.	36 (11.54%)^{A}	45 (14.42%)^{A}	0.781ns
	2. Two times.	122 (39.10%)^{A}	114 (36.54%)^{A}	
	3. Three times or more.	101 (32.37%)^{A}	94 (30.13%)^{A}	
	4. Sometimes.	30 (9.62%)^{A}	30 (9.62%)^{A}	
	5. I forget to brush sometimes.	16 (5.13%)^{A}	22 (7.05%)^{A}	
	6. I don't brush my teeth.	7 (2.24%)^{A}	7 (2.24%)^{A}	
What do you use for cleaning your teeth? (n=825)	1. Brush + toothpaste.	297 (70.21%)^{A}	288 (71.64%)^{A}	0.642ns
	2. Dental floss.	22 (5.20%)^{A}	21 (5.22%)^{A}	
	3. Mouthwash.	59 (13.95%)^{A}	55 (13.68%)^{A}	
	4. Toothpicks.	38 (8.98%)^{A}	26 (6.47%)^{A}	
	5. I don't brush my teeth.	5 (1.18%)^{A}	8 (1.99%)^{A}	
	6. I do not know.	2 (0.47%)^{A}	4 (1.00%)^{A}	
When do you brush your teeth? (n=624)	1. Morning.	28 (8.97%)^{A}	24 (7.69%)^{A}	0.973ns
	2. Noon (after lunch).	14 (4.49%)^{A}	12 (3.85%)^{A}	
	3. Before going to bed.	41 (13.14%)^{A}	43 (13.78%)^{A}	
	4. At morning and before going to bed.	127 (40.71%)^{A}	133 (42.63%)^{A}	
	5. At morning, after lunch and before going to bed.	94 (30.13%)^{A}	89 (28.53%)^{A}	
	6. I don't brush my teeth.	6 (1.92%)^{A}	8 (2.56%)^{A}	
	7. I do not know.	2 (0.64%)^{A}	3 (0.96%)^{A}	
How long do you brush your teeth? (n=624)	1. Less than one minute.	18 (5.77%)^{A}	24 (7.69%)^{A}	0.738ns
	2. One minute.	72 (23.08%)^{A}	79 (25.32%)^{A}	
	3. Two minutes.	83 (26.60%)^{A}	77 (24.68%)^{A}	
	4. More than two minutes.	90 (28.85%)^{A}	87 (27.88%)^{A}	
	5. I don't brush my teeth.	5 (1.60%)^{A}	8 (2.56%)^{A}	
	6. I don't know.	44 (14.10%)^{A}	37 (11.86%)^{A}	

Values with different superscript letters within the same horizontal row are significantly different *; significant (p < 0.05) ns; non-significant (p>0.05)

Table 5: Regression analysis model predicting learning method from gender and educational stage for study participants (N=624)

Parameter	Coefficient	SE	Odds ratio	Confidence level		t-value	p-value
				Lower	Upper		
Intercept	0.75	0.15	2.11	1.58	2.82	5.07	<0.001*
Learning method (online)[1]	1.22	0.15	3.38	2.51	4.60	7.90	<0.001*
Gender (female)[2]	0.07	0.14	1.07	0.81	1.42	0.50	0.620ns
School grade(4th grade)[3]	0.04	0.15	1.04	0.78	1.39	0.30	0.765ns

1= reference category (face-to-face method), 2= reference category (male), 3= reference category (3rd grade), *; significant (p < 0.05) ns; non-significant (p>0.05)

Discussion

The current study aimed to compare the effect of face-to-face and online oral health education methods on the knowledge and practice levels of school children residing in Egypt.

The study revealed statistically significant improvements in knowledge (P <0.001) and practice levels in the face-to-face OHE group compared to its online counterpart.

As for the study participants, the age range of 7-9 years old is equivalent to grades 3 and 4 of the primary stage in Egypt, with 7 years old (3rd grade) as the youngest participant and 9 years old (4th primary) as the oldest participant. Participants could read and write the English language provided in the study questionnaire. Also, participants had no issues understanding the English language used occasionally during the oral hygiene instructions.

Due to the clustering system used for the classes, a compensatory increase in sample size was applied in our sample size calculation to maintain power. This increase in sample size is in accordance with Niranjan et al[22] who applied a clustering system to their oral health education program. Also, a regression analysis model was presented in our study to reduce the clustering effect on the results.

In terms of OH knowledge score assessment, the effect of the face-to-face OHE session showed statistically significant improvement in the knowledge scores of the participants in comparison to the online OHE session which reported little improvement in the knowledge scores.

This difference between groups may be due to technical difficulties in accessing the online OHE materials despite being available for a week. When performing a quick interview with a random sample of the participants it was reported that many of the participants did not use the online OHE education material for various reasons, including lack of time after school, technical issues accessing the WhatsApp and Microsoft Teams groups, lack of commitment from the participants and their parents, technological literacy of the parents or the participants who claimed that the online OHE materials did not appear for them despite different reports from their peers. On the other hand, the participants in the face-to-face OHE group showed genuine interest in learning and enjoyed the educational material presented using the flashy images and activities performed during their session.

The improvement in the knowledge scores of the face-to-face OHE group is in accordance with various studies[16,23,24] where the implementation of live activities with the participants showed better OH knowledge scores since that would be more attractive and interactive.

As regards the online OHE group, OHE sessions showed no statistically significant improvements in OH knowledge scores. This finding is supported by the findings of Al-Ak'hali et al[26] who reported that Implementing WhatsApp instant messages does not appear to add extra benefit to the traditional motivation and education on oral hygiene practices in terms of changes in

Plaque-Index and Gingival-Index over time in patients with gingivitis. In contrast to our findings, the results reported by Aljafari et al[27] and Aboubakr et al[28] showed improved OH knowledge for the participants when using an online-based OHE session that included games and/or PowerPoint presentation demonstrating OH knowledge and practices.

In terms of OH self-reported practice assessment, When comparing the face-to-face OHE post-intervention results to its pre-intervention results, there is a statistically significant improvement in the number of times the participants brush their teeth per day. This clarifies the impact of the face-to-face OHE session on the participants' OH.

This improvement is in line with the study conducted by Tolvanen et al[29] where recipients received a comprehensive OHE session and showed improved results post-intervention.

The previous findings of the face-to-face OHE group are in accordance with Subedi et al[16] who conducted a short-term OHE session for students in Nepal at regular intervals. They reported that on every post-intervention assessment of the KAP results show improved KAP in comparison to the pre-intervention assessment, which in turn reinforces the hypothesis that face-to-face OHE sessions positively impact the KAP of the participants. It is noted that Subedi et al used a questionnaire that involved pictures instead of close-ended questions, which might have made the questionnaire easier to comprehend than a written one.

For the online OHE group, there was no notable improvement regarding their practice assessment, which is in contrast to the findings of Aljafari et al[25] who conducted their study on students residing in London and reported an improvement in the behavioral aspects of oral hygiene in their participants. This may be due to the difference between OHE methods since Aljafari et al had used an online computer game instead of the cartoon presentation used in this study.

The general results of the current study are in agreement with Halawany et al[23] who conducted a study on different school stages in Riyadh, Saudi Arabia. Despite having a younger age group and the usage of a pictorial questionnaire instead of a written one, they reported a significant improvement in the OH practice among their participants after conducting a face-to-face OHE session that was assessed after a 6-week interval.

Obtained data were inserted into a regression analysis model to reduce the clustering effect and determine the main factor affecting the OH knowledge levels in the study participants. Its results showed that neither gender nor school affected the knowledge levels, in comparison to the educational method (face-to-face and online) that showed statistically significant improvement in OH knowledge levels when participants received the face-to-face OHE session. This model shows that the educational method might be the main contributing factor to an individual's knowledge level.

The current findings of the study show that the useability of online methods to deliver OH education still needs to be further explored. Direct interaction with children is considered ideal because it ensures engagement and communication between both the health educator and the recipient. More research is needed to further explore the potential of using various online methods to deliver OH education since they will be useful for the hard-to-reach population.

Strengths and limitations

Our study is not without limitations. First, using a non-native language for the study The research addresses several limitations and strengths associated with a study on oral hygiene education (OHE)

among Egyptian children. Major limitations include potential response bias in the questionnaire, lack of long-term impact measurement like caries and gingival indices, difficulty in conducting long-term assessments due to follow-up losses and new permission requirements post-COVID, and limited generalizability of results given the study's focus on two private schools. Conversely, the study's strengths lie in the innovative use of Prezi TM for educational material, resulting in heightened engagement among participants. Teachers received instructional booklets to foster a healthy environment, and online OHE sessions proved effective not just for evaluating oral hygiene knowledge but also for aiding disadvantaged groups, including those with disabilities. Despite its limitations, the study provides a promising foundation for developing effective OHE programs tailored to Egyptian children.

Conclusion

Face-to-face OHE sessions which include interactive activities and colorful educational materials are effective methods to improve short-term oral health knowledge and practice of school children in comparison to the online method.

Recommendation

Further randomized controlled trials with long-term follow-up periods to compare the effect of face-to-face and online OHE sessions on the knowledge and practice levels of children in different age groups. More studies involving online OHE programs with more innovative methods are needed to further explore the effectiveness of different methods of online OHE programs. Studies that include both public and private schools are recommended to further explore the generalizability of the results on Egyptian schoolchildren.

We hope from this study to be a steppingstone to the future of oral health education methods to improve oral health-related knowledge and practice of Egyptian children.

List of Abbreviations

World Health Organization (WHO), Oral health education (OHE), Oral health (OH), American Dental Association (ADA), Oral health-related quality of life (OHRQoL), FD-ASU: Faculty of Dentistry, Ain Shams University.

Declarations

Ethical consideration

An informed consent has been obtained from all the subjects and their legal guardians through an online message that was sent to the participant's caregivers explaining the educational sessions in detail and those who did not want their children to be included have sent their refusal to the school board. Verbal approval was obtained from the children included in the study before conducting it in the classrooms.

Participants who opted out of the study and those who were excluded from the study still received oral health education sessions, but their data were not included in the data analysis. All the participants' data obtained was protected and their anonymity was maintained

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Availability of data and materials

The research data will be available upon a reasonable request to the corresponding author.

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Authors' contribution
This study was carried out with the collaboration of all authors.
Conceptualization and design of the study: AB, NA, OT. Data collection: OT. Manuscript drafting: AB, NA, OT. All authors read and approved the final manuscript.

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