

EFFECT OF SCHOOL DENTAL EDUCATION PROGRAM: A QUASI-EXPERIMENTAL STUDY

EFEITO DE UM PROGRAMA ESCOLAR DE EDUCAÇÃO EM SAÚDE BUCAL: ESTUDO QUASE-EXPERIMENTAL

EFFECTO DE UN PROGRAMA ESCOLAR DE EDUCACIÓN EN SALUD BUCODENTAL: ESTUDIO CUASIEXPERIMENTAL

Nasreen Hamarash Hamonari¹
Dilan Burhan Yousif²

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Objective: This study aimed to evaluate the effectiveness of a school-based oral health education program designed to improve oral hygiene knowledge, behaviors, and gingival health status among school-aged children. **Methods:** A quasi-experimental approach included 75 children, using pre- and post-intervention assessments. Structured interviews were used to evaluate oral hygiene knowledge and behaviors, while clinical examinations measured gingival and plaque levels using the Gingival Index (GI) and Plaque Index (PI). The program included motivational activities, group discussions, and hands-on practice. **Results:** The intervention resulted in improvement in clinical indicators, with reductions in mean PI and mean GI. The proportion of children who did not brush their teeth decreased from 8% to 4% ($p < 0.001$). Positive trends were also observed in brushing frequency and the use of fluoride toothpaste, although they did not reach statistical significance. **Conclusion:** School-based oral health education increases knowledge and

Corresponding author: Nasreen Hamarash Hamonari, nasreen.hamonari@khcms.edu.krd

¹Kurdistan Higher Council of Medical Specialties, Erbil City, Kurdistan Region, Iraq. <https://orcid.org/0009-0005-8674-9489>

²Kurdistan Higher Council of Medical Specialties, Erbil City, Kurdistan Region, Iraq. <https://orcid.org/0000-0003-3582-6147>

promotes positive behaviors, contributing to decreased plaque and gingival inflammation. Ongoing reinforcement and follow-up are recommended to maintain these benefits.

Descriptors: Oral Hygiene. Toothbrushing. Health Education. Schools. Preventive Dentistry. Quasi-Experimental Study.

Objetivo: Este estudo teve como objetivo avaliar a efetividade de um programa escolar de educação em saúde bucal voltado a aprimorar o conhecimento sobre higiene oral, os comportamentos de cuidado e o estado de saúde gengival entre crianças em idade escolar. Métodos: Estudo quase experimental com 75 crianças, utilizando avaliações pré e pós-intervenção. Entrevistas estruturadas foram empregadas para aferir conhecimento e comportamentos de higiene bucal, enquanto exames clínicos mensuraram níveis gengivais e de placa por meio do Índice Gengival (IG) e do Índice de Placa (IP). O programa incluiu atividades motivacionais, discussões em grupo e prática supervisionada. Resultados: Observou-se melhora dos indicadores clínicos, com reduções nas médias de IP e IG. A proporção de crianças que não escovavam os dentes diminuiu de 8% para 4% ($p < 0,001$). Também foram identificadas tendências positivas na frequência de escovação e no uso de dentífrico fluoretado, embora sem significância estatística. Conclusão: A educação em saúde bucal no ambiente escolar aumenta o conhecimento e promove comportamentos positivos, contribuindo para a redução da placa e da inflamação gengival. Recomenda-se reforço contínuo e acompanhamento para manutenção dos benefícios.

Descritores: Higiene Bucal. Escovação Dentária. Educação em Saúde. Escolas. Odontologia Preventiva. Estudo Quase-Experimental.

Objetivo: El objetivo de este estudio fue evaluar la eficacia de un programa escolar de educación en salud bucodental destinado a mejorar los conocimientos sobre higiene oral, los hábitos de cuidado y el estado de salud gingival entre los niños en edad escolar. Métodos: Estudio cuasi experimental con 75 niños, utilizando evaluaciones previas y posteriores a la intervención. Se utilizaron entrevistas estructuradas para evaluar los conocimientos y los comportamientos de higiene bucal, mientras que los exámenes clínicos midieron los niveles gingivales y de placa mediante el Índice Gingival (IG) y el Índice de Placa (IP). El programa incluyó actividades motivacionales, debates en grupo y prácticas supervisadas. Resultados: Se observó una mejora en los indicadores clínicos, con reducciones en los promedios de IP e IG. La proporción de niños que no se cepillaban los dientes disminuyó del 8 % al 4 % ($p < 0,001$). También se identificaron tendencias positivas en la frecuencia del cepillado y el uso de dentífrico fluoretado, aunque sin significación estadística. Conclusión: La educación en salud bucodental en el entorno escolar aumenta el conocimiento y promueve comportamientos positivos, lo que contribuye a la reducción de la placa y la inflamación gingival. Se recomienda un refuerzo continuo y un seguimiento para mantener los beneficios.

Descriptores: Higiene Bucal. Cepillado Dental. Educación en Salud. Escuelas. Odontología preventiva. Estudio Cuasiexperimental.

Introduction

Oral health represents a vital component of overall health and well-being, enabling children to eat, speak, and socialize without pain or discomfort. Globally, oral diseases affect a large proportion of the population, with dental caries and periodontal conditions ranking among the most common yet preventable health problems in children. These oral diseases significantly impact children's quality of life, causing pain, discomfort, difficulties in eating and speaking, and potentially affecting their school attendance and performance^(1,2).

Early childhood and school age represent critical periods for establishing lifelong health behaviors. Schools serve as ideal environments

to provide oral health education and promote healthy habits. When children adopt appropriate oral hygiene practices, they not only enhance their health but also positively influence their families and communities, amplifying the benefits of educational programs^(3,4,5).

Health education programs that integrate oral health promotion and interactive learning strategies demonstrate effectiveness in preventing dental diseases among children. Studies show that such interventions can reduce the prevalence of dental caries and improve gingival health by up to 80% in school-aged children^(6,7). Oral health education combines knowledge dissemination with behavioral interventions to encourage positive hygiene practices, which are critical for

preventing disease and fostering long-term oral health^(8,9).

The primary goal of oral health education programs is to enhance children's knowledge and encourage adherence to effective oral hygiene routines, resulting in measurable improvements in plaque control and gingival health. Numerous studies confirm the positive impact of these programs on oral health outcomes in school-aged populations^(10,11).

This study aims to evaluate the effectiveness of a school-based oral health education program in improving knowledge in relation to oral hygiene practices and gingival health among school-aged children in Erbil City.

Methods

A quasi-experimental design assessed the effectiveness of an oral health education program among primary school children in Erbil City. Ethical clearance was obtained from the Kurdistan Higher Council of Medical Specialties (Reg. No. 1610, July 3, 2024). Permissions from school administrators were secured, and written informed consent was obtained from parents or guardians before participation.

Children aged 8 years attending primary schools in Erbil, medically healthy, not currently undergoing orthodontic treatment, and capable of cooperating during clinical assessments were included. Exclusion criteria comprised children with urgent dental conditions, ongoing orthodontic therapy, systemic health issues, or lacking parental consent.

Baseline Assessment (Pre-Intervention)

Baseline data collection involved administering a structured questionnaire to evaluate oral health knowledge and attitudes, supplemented by individual interviews regarding oral hygiene behaviors. Clinical oral examinations assessed gingival status using the Gingival Index (GI)⁽¹²⁾ and plaque accumulation using the Plaque Index (PI)⁽¹³⁾.

Oral examinations adhered to World Health Organization protocols⁽¹⁴⁾. Children were examined in seated positions under appropriate

lighting using dental mirrors and probes to evaluate GI and PI. Following examinations, participants were provided with fluoridated toothpaste and toothbrushes and were instructed to brush twice daily.

A pilot study was conducted on 15 children matching the study's demographic to refine procedures, train examiners, and evaluate feasibility. Two calibrated dentists performed clinical assessments using GI and PI. Calibration reliability was strong, with intra-examiner kappa coefficients of 0.89 (PI) and 0.88 (GI) for Examiner 1, and 0.86 (PI) and 0.89 (GI) for Examiner 2. Inter-examiner reliability was also high ($\kappa = 0.90$ for PI and 0.87 for GI).

Participants were interviewed using the following questions:

Do you use a toothbrush and toothpaste? (Yes/No)

Does your toothpaste contain fluoride? (Yes/No/Don't know)

How many times do you brush your teeth daily? (Once/Twice/Three times)

Do you replace your toothbrush regularly? (Yes/No/Don't know)

Does brushing prevent cavities? (Yes/No)

When do you usually brush your teeth? (After meals/Morning/Before bed)

How frequently do you visit the dentist? (Never/Regularly/Only emergencies)

Primary outcomes included: reduction in plaque levels (PI), improvement in gingival health (GI), enhancement of oral hygiene behaviors (e.g., brushing frequency, fluoride toothpaste use) and increased oral hygiene knowledge.

The oral health education intervention was structured into five phases:

Motivational Phase: Introduced foundational concepts regarding oral health, emphasizing the significance of healthy teeth and gums, diet, and oral hygiene, supported by an educational manual.

Training Phase: Demonstrated correct toothbrushing techniques using dental models.

Discussion Phase: Facilitated interactive group discussions to promote active learning.

Visual Learning Phase: Delivered educational videos illustrating proper brushing methods and consequences of poor oral hygiene.

Practical Reinforcement Phase: Presented images depicting healthy dentition, demonstrated flossing techniques, and discussed gingivitis.

Two weeks following the program, participants completed the same knowledge questionnaire. Correct answers were scored as 1 and incorrect as 0, yielding a cumulative knowledge score. Clinical reassessments of PI and GI were performed to evaluate changes in oral health status.

Data analysis was conducted using IBM SPSS Statistics version 25.0. Means and standard deviations were calculated to describe the Plaque Index (PI) and Gingival Index (GI) before and after the intervention. Differences in mean PI and GI scores between baseline and follow-up were examined using the paired samples t-test. The Wilcoxon signed-rank test assessed changes in paired categorical variables related to oral

hygiene practices, knowledge, and behaviors. Statistical significance was set at a p-value below 0.05.

Results

The baseline mean score for the Plaque Index (PI) among 75 eight-year-old students was 0.71 (SD = 0.55), and for the Gingival Index (GI), it was 0.63 (SD = 0.61), indicating moderate levels of plaque accumulation and gingival inflammation prior to the oral health education intervention.

Effect of the Educational Program on Clinical Indices

Paired samples t-tests were conducted to assess changes in PI and GI before and after the intervention. There were statistically significant reductions in both indices following the educational program. Specifically, PI decreased from 0.71 to 0.42 and GI decreased from 0.63 to 0.35, $p < 0.001$. (Table 1)

Table 1 - Comparison of PI and GI Before and After Educational Program (N = 75)

Index	Timepoint	Mean	SD	SE	p-value
Plaque Index (PI)	Before	0.71	0.55	0.06	<0.001
	After	0.42	0.43	0.05	
Gingival Index (GI)	Before	0.63	0.61	0.07	<0.001
	After	0.35	0.48	0.06	

SD: Standard deviation; SE: Standard error. Statistically significant at $p \leq 0.05$.

Note: Pair 1 corresponds to the comparison of PI before and after the program, and Pair 2 corresponds to the comparison of GI before and after the program.

Changes in Toothbrushing Practices, Frequency, and Fluoridated Toothpaste Use

Changes in toothbrushing habits and related behaviors before and after the program are summarized in Table 2. The percentage of students brushing with toothbrush and toothpaste increased slightly from 92% to 96%, although this difference was not statistically significant ($p = 0.839$). The proportion of students who did not

brush markedly decreased from 8% to 4% ($p < 0.001$).

Use of fluoridated toothpaste increased substantially from 19% to 71%, but this change did not reach statistical significance ($p = 0.063$). Frequency of brushing twice daily rose from 41% to 63%, while those brushing less than once daily declined from 12% to 5%; however, these frequency changes were not statistically significant.

Table 2 - Toothbrushing practices, frequency, and fluoridated toothpaste use before and after educational program (N = 75)

Question/Response	Pre-Education N (%)	Post-Education N (%)	p-value
Toothbrushing Practice (Q1)			
- Yes	69 ⁽⁹²⁾	72 ⁽⁹⁶⁾	0.839
- No	6 ⁽⁸⁾	3 ⁽⁴⁾	<0.001
Use of Fluoridated Toothpaste (Q2)			
- Yes	14 ⁽¹⁹⁾	53 ⁽⁷¹⁾	0.063
- No	11 ⁽¹⁵⁾	6 ⁽⁸⁾	0.546
- I don't know	50 ⁽⁶⁷⁾	16 ⁽²¹⁾	0.513
Brushing Frequency (Q3)			
- Less than once/day	9 ⁽¹²⁾	4 ⁽⁵⁾	0.096
- Once per day	32 ⁽⁴³⁾	21 ⁽²⁸⁾	0.619
- Twice per day	31 ⁽⁴¹⁾	47 ⁽⁶³⁾	0.503
- More than twice/day	3 ⁽⁴⁾	3 ⁽⁴⁾	0.066

Significant at $p \leq 0.05$ *Toothbrushing Timing, Toothbrush Replacement, Knowledge, and Dental Visits*

Table 3 shows changes in brushing timing, toothbrush replacement habits, cavity prevention knowledge, and dental visit frequency. The proportion of students brushing both morning and night increased from 45% to 63%, but this was not statistically significant ($p = 0.362$).

Regular toothbrush replacement rose from 72% to 85%, with an observed reduction in students unsure about replacement intervals ($p = 0.022$).

Knowledge that brushing prevents cavities improved slightly from 81% to 87%, with a significant decrease in incorrect answers ($p = 0.038$). Frequencies of dental visits showed no substantial change.

Table 3 - Toothbrushing Timing, Toothbrush Replacement, Knowledge, and Dental Visits Before and After Educational Program (N = 75)

Question/Response	Pre-Education N (%)	Post-Education N (%)	p-value
Toothbrushing Timing (Q4)			
- Morning	16 ⁽²¹⁾	16 ⁽²¹⁾	0.105
- Noon	1 ⁽¹⁾	0 ⁽⁰⁾	0.323
- Before bed	17 ⁽²³⁾	9 ⁽¹²⁾	0.723
- Other times	7 ⁽⁹⁾	3 ⁽⁴⁾	0.780
- Morning + Night	34 ⁽⁴⁵⁾	47 ⁽⁶³⁾	0.362
Toothbrush Replacement (Q5)			
- Yes	54 ⁽⁷²⁾	64 ⁽⁸⁵⁾	0.566
- No	12 ⁽¹⁶⁾	10 ⁽¹³⁾	0.390
- I don't know	9 ⁽¹²⁾	1 ⁽¹⁾	0.022
Knowledge of Cavity Prevention (Q6)			
- Yes	61 ⁽⁸¹⁾	65 ⁽⁸⁷⁾	0.634
- No	14 ⁽¹⁹⁾	10 ⁽¹³⁾	0.038
Dental Visit Frequency (Q7)			
- Regular	11 ⁽¹⁵⁾	9 ⁽¹²⁾	0.128
- Occasionally	37 ⁽⁴⁹⁾	33 ⁽⁴⁴⁾	0.703
- Emergency	18 ⁽²⁴⁾	22 ⁽²⁹⁾	0.446
- Never	9 ⁽¹²⁾	11 ⁽¹⁵⁾	0.057

Significant at $p \leq 0.05$

Discussion

This research examined the effects of a school-based oral health education (OHE) intervention on both clinical oral health parameters and oral hygiene behaviors among schoolchildren. At baseline, children exhibited moderate levels of dental plaque and gingival inflammation, with mean Plaque Index (PI) and Gingival Index (GI) scores of 0.71 and 0.63, respectively. These findings underscore the critical need for effective preventive strategies during this formative stage to prevent the progression of oral diseases.

Following the educational program, significant improvements were observed in clinical outcomes, with PI and GI scores decreasing to 0.42 and 0.35, respectively. This marked reduction in plaque accumulation and gingival inflammation aligns with previous studies. For example, some studies⁽¹¹⁾ reported notable reductions in PI and improvements in gingival health among adolescents after six months of structured OHE. Similarly, study demonstrated that weekly OHE sessions supported by digital materials and parental involvement significantly enhanced oral health knowledge and attitudes, alongside reductions in plaque levels among 12-year-olds in Iran⁽¹⁵⁾.

While clinical indicators showed statistically significant improvement, behavioral changes were less pronounced. Positive trends such as increased use of toothbrushes and toothpaste, and a reduction in the number of children who did not brush, were observed but did not reach statistical significance.

Notably, the use of fluoridated toothpaste increased sharply from 19% to 71%, indicating enhanced awareness in relation to preventive dental care. Supporting these findings, a randomized controlled trial among children aged 10 to 12 in Al-Kharj, Saudi Arabia, showed that a two-week structured OHE program significantly improved oral hygiene knowledge⁽¹⁶⁾. This aligns with our results and confirms the effectiveness of short-term, well-designed educational interventions in enhancing oral health knowledge in school-aged children.

Additionally, a quasi-experimental study in rural Taiwan, evaluating the impact of a health-promoting school strategy on dental plaque and preventive behaviors among school children⁽¹⁷⁾. After three months, the intervention group showed greater plaque reduction, improved oral health knowledge, and better attitudes.

Another study⁽¹⁸⁾ reported sustained behavioral improvements in 8- to 10-year-old children following a year-long weekly oral health education program in Myanmar. Their study emphasized the importance of continuous, long-term education in promoting and maintaining oral hygiene knowledge and behaviors, highlighting the need for ongoing reinforcement to achieve lasting behavioral change in children.

Specific behaviors such as brushing frequency and timing also showed promising, although non-significant, increases. The proportion of children brushing twice daily rose from 41% to 63%, and those brushing both in the morning and at night increased from 45% to 63%. These trends indicate a positive effect of the program but also highlight the necessity for continuing reinforcement and active caregiver participation to solidify new habits. Correspondingly, knowledge-based behaviors improved significantly: regular toothbrush replacement increased from 72% to 85% ($p = 0.022$), and understanding brushing as a method for caries prevention rose from 81% to 87%, accompanied by a notable decline in incorrect knowledge ($p = 0.038$).

Despite these encouraging results, the frequency of dental visits remained largely unchanged, suggesting that barriers beyond education, such as accessibility issues, financial constraints, or cultural attitudes, may limit the utilization of dental care services.

The effectiveness of culturally tailored, school-based OHE programs is well established, especially when repeated education combines with active involvement of parents and teachers, leading to significant improvements in children's oral health. A review with 18 studies involving children aged 6–12 found improvements in oral health knowledge, brushing habits, fluoridated toothpaste use, and reductions in plaque and

gingival bleeding⁽¹⁹⁾. Similarly, a separate analysis of 34 studies from low- and middle-income countries and reported significant reductions in dental caries and plaque scores following school-based interventions focusing on skills-based education, teacher training, access to oral health services, and parental engagement⁽²⁰⁾.

Furthermore, highlighted the importance of practical skills training and stakeholder involvement in reducing oral disease burden⁽²⁰⁾. Digital methods have also proven effective, significant gains in oral health knowledge through computer-assisted learning (11,21). Similarly, a recent systematic review⁽²²⁾ found that game-based teaching significantly improved oral health knowledge, hygiene scores, and reduced plaque and debris, outperforming traditional methods like verbal instruction and posters.

Collectively, these findings confirm that school-based OHE programs effectively improve oral health and behaviors in children. However, sustained and significant behavioral changes likely require longer, more frequent interventions with stronger family and community engagement.

This study had some limitations. The absence of examiner blinding may have introduced observational bias. Additionally, external environmental factors and individual lifestyle variations were not accounted for, which could have influenced the results. Furthermore, the short follow-up period limited the ability to assess the long-term sustainability regarding improvements in oral health practices.

Conclusion

This study's results highlight the effectiveness of school-based oral health education programs in improving students' knowledge, attitudes, and practices regarding oral hygiene. These improvements contributed to noticeable reductions in plaque accumulation and gingival inflammation, indicating better overall oral health among participants. While not all behavioral changes were statistically significant, the program showed a positive impact on oral

hygiene habits. Further efforts should focus on supporting children with lower adherence to oral hygiene routines by incorporating strategies that enhance cooperation during dental visits and encourage consistent self-care. Increasing involvement from families and communities alongside school initiatives may further improve the effectiveness and lasting impact of oral health outcomes in children.

Collaborations:

- 1 – conception and planning of the project: Nasreen Hamarash Hamonari;
- 2 – analysis and interpretation of data: Dilan Burhan Yousif;
- 3 – writing and/or critical review: Nasreen Hamarash Hamonari and Dilan Burhan Yousif;
- 4 – approval of the final version: Nasreen Hamarash Hamonari.

Competing interests

There are no competing interests.

Data Availability Statement

The derived data supporting the findings of this study are available from the corresponding author NH, upon reasonable request.

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