

Research Article

Impact of School Oral Health Education on Caries Experience and Oral Hygiene Status of Primary School Children: A Comparative Study

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ABSTRACT

Background: Oral health education in schools can have a positive impact on oral hygiene practices and clinical oral health in primary school children.

Objective: To evaluate the effect of structured school-based oral health education on caries experience and oral hygiene status among primary school children aged 6-12 years.

Methodology: The study was a comparative interventional study of 12 months' duration. There were a total of 132 children who were enrolled and 66 (50.00%) were assigned to the intervention group and 66 (50.00%) to the comparison group. The intervention was conducted for three months and the OHI-S and DMFT/dmft indices were used for the assessment of oral hygiene and caries experience at baseline and follow-up.

Results: Of 132 children, 120 (90.91%) completed follow-up, including 60 (50.00%) in each group. Mean OHI-S decreased from 2.18 ± 0.61 to 1.24 ± 0.49 in the intervention group, compared with 2.21 ± 0.64 to 2.05 ± 0.62 in the comparison group ($p < 0.001$). Good oral hygiene increased from 8 (13.33%) to 31 (51.67%) in the intervention group. Baseline caries experience was present in 88 (66.67%) children, while follow-up caries experience was 39 (65.00%) and 43 (71.67%) in the intervention and comparison groups, respectively ($p = 0.436$).

Conclusion: Structured school-based oral health education improved oral hygiene status and related practices, but a clear short-term effect on cumulative caries experience was not demonstrated.

Keywords: School Oral Health, Oral Health Education, Dental Caries, OHI-S, DMFT, Dmft, Primary School Children.

INTRODUCTION

Children attending primary schools are a target population of significant importance for oral health promotion since the habits they develop in childhood can affect oral health in later life. One of the most prevalent oral diseases among children is dental caries, which can cause pain, make mealtimes uncomfortable, lead to absenteeism from school and affect the quality of life [1]. Oral health education is delivered easily and in a structured environment in school because children are available on a regular basis and have access to organized activities in

the classroom and supervised preventive programs [2]. Oral health education content in schools can cover the topics of oral care, toothbrushing, fluoride toothpaste, dietary habits, plaque control and proper use of oral health services, which aim at enhancing the knowledge, attitude and oral care behavior of children [3].

Poor oral hygiene is an important modifiable factor associated with the development and progression of dental caries and gingival inflammation. The presence of dental plaque creates a favourable environment for the

growth of cariogenic microorganisms and can be a factor in the development of oral diseases if adequate plaque control is not achieved [4]. Oral hygiene education programs conducted in school have been shown to enhance oral hygiene among children and to decrease the amount of plaque [5]. The improvements in oral health knowledge, tooth brushing habits, use of fluoridated toothpaste, plaque scores and gingival bleeding were reported in children after educational interventions in a systematic review of school dental health education programs [3]. Evidence from systematic reviews and meta-analyses also shows that interventions in primary schools have beneficial effects on plaque control, with evidence of reductions in dental caries, though the certainty and size of the effects depends on the type of interventions and the study design [6].

The impact of school oral health education could be influenced by the intensity, duration, frequency and delivery of the oral health education. Opportunities for children to turn oral health knowledge into practice may be provided through interventions with teacher guidance, dental professional involvement, supervised activities, demonstrations, visual aids and repeated reinforcement [2,7]. Meta-analysis of oral health educational interventions for school children found that various methods of education resulted in better oral hygiene status, but that there were differences between the methods of education that were used [8]. This is significant for long-term maintenance of these improvements, since behavioral change obtained through an educational program can decrease after reinforcement stops [2,9].

Although growing evidence of the effectiveness of school-based oral health promotion, the impact of education can vary dependent on the demographic make up of the population, methods of education, baseline oral health status and access to preventative dental services [10]. School-based interventions have been shown to have positive impacts on oral hygiene and oral health-related behaviors, and the evidence of long-term prevention of dental caries is somewhat mixed [11,12]. Thus, comparative analysis of the caries experience, oral hygiene status in children who have attended a structured school oral health education program and those who have received routine school activities, can give valuable information on the potential role of education in the management of the oral health status of children. Based on this, the present study was designed, so as to compare the

caries experience and oral hygiene status of the children in primary school who had been exposed to school-based oral health education and those who were not.

Objective

The aim of this study was to assess the impact of this structured intervention on the caries experience (DMFT/dmft) and oral hygiene status (OHI-S) of 6- to 12-year-old children in school when compared to the same children in an untreated comparison group, from baseline to post-intervention assessment.

METHODOLOGY

Study Design and Setting

The comparative school based interventional study was carried out for 12 months under the institutional guidance. Recruitment of participants, clinical examination, intervention delivery, and follow up were done. Both primary school children age group 6-12 years and children with structured oral health education and those children with continued routine school activities were included in the study.

Study Duration and Population

The study lasted for a period of 12 months (preparation, recruitment, baseline assessment, intervention, follow-up, and data analysis). The structured oral health education intervention was given for 3 months. The study population were eligible children of age 6-12 years old attending school.

Sample Size and Sampling Technique

A total of 132 children were recruited and 66 children participated in each group. A 10% allowance for loss to follow-up and/or incomplete data was considered and a final analyzable sample of approximately 120 children was expected. The sampling was done in the schools of GPS and participants were selected until the desired sample size was reached.

Eligibility Criteria

Children aged 6-12 years attending GPS school who could attend the educational activities and clinical examination and had written consent from their parents/guardians were included. Children who could not be included in the intervention or complete the clinical examination were not included. Any missing baseline or follow-up data subjects were omitted from analyses that required both baseline and follow-up data.

Study Groups and Allocation

There were 66 participants in the intervention group and 66 participants in the comparison group. The intervention group was provided with the structured oral health education program, and the comparison group was not provided with the structured oral health education program; they were provided with the routine school activity. Baseline characteristics were obtained to evaluate the comparability of groups.

Baseline Clinical Assessment

A standardized oral examination was performed before commencement of the intervention. The oral hygiene status was graded by the Simplified Oral Hygiene Index (OHI-S) and caries experience was evaluated by DMFT/dmft index, based on the dentition status. A structured data collection form was used to collect relevant demographic and baseline clinical data.

School Oral Health Education Intervention

The intervention group was given a structured oral health education intervention for 3-months. The program helped participants learn the proper technique for brushing their teeth, how often to brush, the importance of fluoride toothpaste, how to control their plaque, dietary habits that affect the risk of tooth decay, how to maintain their oral health, and how to use dental services correctly. Sessions took place once a week, as well as reinforcement sessions. The recommended oral-health practices were reinforced through verbal instruction, visual materials, demonstrations, and practical instruction. The comparison group did normal school activities without the intervention.

Follow-Up Assessment

After 3-months intervention, participants were re-evaluated with the same procedures and clinical indices as at baseline. Changes in OHI-S score between baseline and follow-up was used as the primary assessment whereas changes in DMFT/dmft scores was used as a secondary assessment.

Assessment of Caries Experience and Oral Hygiene

The caries experience was evaluated by the DMFT index for permanent dentition and dmft index for primary dentition, with both teeth that were decayed, missing due to caries and filled being recorded. Standardized examination and scoring procedures were used to determine the oral hygiene status, following the OHI-S. The

main clinical endpoint was the difference between the baseline and follow-up scores of the OHI-S. The secondary outcome was the change in DMFT/dmft score. OHI-S was chosen as the main outcome because it is more sensitive to changes in oral health practices over a short time period, while DMFT/dmft is a measure of cumulative caries experience.

Examiner Calibration and Reliability

Prior to the main data collection, the examiner was trained and calibrated in the assessment of OHI-S and DMFT/dmft. The use of standardised diagnostic and recording procedures. To evaluate intra-examiner reliability, selected participants were re-evaluated prior to the beginning of the main clinical evaluation.

Study Variables and Outcome Measures

The main independent variable was the exposure to the structured oral health education intervention in school settings. Change in OHI-S score was the primary outcome. The secondary outcome was the change in DMFT/dmft score from baseline to follow-up. Age and other baseline variables, which were relevant, were recorded as explanatory or confounding variables.

Statistical Analysis

The SPSS version 25 was used for data analysis. The continuous variables were summarized as mean $\pm$ SD or median (IQR), as appropriate, and categorical variables were summarized as frequencies and percentages. Prior to the selection of statistical tests, data distribution was evaluated. The main analysis was the change in the OHI-S score between the groups at baseline and follow-up. Using appropriate parametric or non-parametric tests, within- and between-group changes in OHI-S and DMFT/dmft were analyzed. Where appropriate, multivariable analysis was done to control for pertinent baseline variables. When available, effect estimates were presented with 95% CIs. A 2-tailed p-value < 0.05 was deemed to be significant.

RESULTS

A total of 132 children were enrolled, including 66 (50.00%) in the intervention group and 66 (50.00%) in the comparison group (table 1). At follow-up, 120 (100.00%) participants completed the assessment, with 60 (50.00%) from each group. Twelve (100.00%) participants were lost to follow-up.

Table 1. Distribution of Participants According to Study Group

Study Group	Baseline n (%)	Completed Follow-up n (%)	Lost to Follow-up n (%)
Intervention group	66 (50.00)	60 (50.00)	6 (50.00)
Comparison group	66 (50.00)	60 (50.00)	6 (50.00)
Total	132 (100.00)	120 (100.00)	12 (100.00)

Among 132 children, 44 (33.33%) were aged 6–8 years, 46 (34.85%) were aged 9–10 years, and 42 (31.82%) were aged 11–12 years (table 2). The overall distribution by sex was equal, with 66 (50.00%) males and 66 (50.00%) females. The demographic characteristics were broadly comparable between the two groups.

Table 2. Baseline Demographic Characteristics of Participants According to Study Group

Characteristic		Intervention (n=66)	Comparison (n=66)	Total (N=132)
Age group (years)	6–8	21 (31.82)	23 (34.85)	44 (33.33)
	9–10	24 (36.36)	22 (33.33)	46 (34.85)
	11–12	21 (31.82)	21 (31.82)	42 (31.82)
Gender	Male	34 (51.52)	32 (48.48)	66 (50.00)
	Female	32 (48.48)	34 (51.52)	66 (50.00)
	Total	66 (100.00)	66 (100.00)	132 (100.00)

At baseline, visible plaque was present in 94 (71.21%) children, gingival bleeding in 76 (57.58%), and dental caries in 88 (66.67%), shown in table 3. Dental caries was present in

43 (65.15%) children in the intervention group and 45 (68.18%) in the comparison group. Baseline oral health characteristics were generally comparable between groups.

Table 3. Baseline Oral Health Characteristics of Participants According to Study Group

Oral Health Characteristic	Intervention (n=66)	Comparison (n=66)	Total (N=132)
Visible plaque present	48 (72.73)	46 (69.70)	94 (71.21)
Gingival bleeding present	37 (56.06)	39 (59.09)	76 (57.58)
Dental caries present	43 (65.15)	45 (68.18)	88 (66.67)
No dental caries detected	23 (34.85)	21 (31.82)	44 (33.33)

The mean baseline OHI-S scores were comparable between the intervention and comparison groups (2.18 ± 0.61 vs. 2.21 ± 0.64 ; $p=0.786$), shown in table 4. At follow-up, OHI-S decreased to 1.24 ± 0.49 in the

intervention group compared with 2.05 ± 0.62 in the comparison group. The between-group difference in change was statistically significant (-0.78 ; $p<0.001$).

Table 4. Comparison of OHI-S Scores Between Intervention and Comparison Groups at Baseline and Follow-Up

Assessment	Intervention (n=60) Mean $\pm$ SD	Comparison (n=60) Mean $\pm$ SD	Mean Difference	p-value
Baseline OHI-S	2.18 ± 0.61	2.21 ± 0.64	-0.03	0.786
Follow-up OHI-S	1.24 ± 0.49	2.05 ± 0.62	-0.81	<0.001
Change in OHI-S	-0.94 ± 0.48	-0.16 ± 0.43	-0.78	<0.001

Note: OHI-S = Simplified Oral Hygiene Index; SD = standard deviation. Negative change indicates improvement in oral hygiene status.

At baseline, good oral hygiene was observed in 8 (13.33%) intervention and 7 (11.67%) comparison participants (table 5). At follow-up,

good oral hygiene increased to 31 (51.67%) in the intervention group compared with 10 (16.67%) in the comparison group. Poor oral

hygiene decreased to 1 (1.67%) and 9 (15.00%), respectively.

Table 5. Distribution of Participants According to OHI-S Category at Baseline and Follow-Up

OHI-S Category	Intervention Baseline n (%)	Intervention Follow-up n (%)	Comparison Baseline n (%)	Comparison Follow-up n (%)
Good (0.0–1.2)	8 (13.33)	31 (51.67)	7 (11.67)	10 (16.67)
Fair (1.3–3.0)	42 (70.00)	28 (46.67)	43 (71.67)	41 (68.33)
Poor (3.1–6.0)	10 (16.67)	1 (1.67)	10 (16.67)	9 (15.00)
Total	60 (100.00)	60 (100.00)	60 (100.00)	60 (100.00)

Note: OHI-S = Simplified Oral Hygiene Index. Data are presented as frequency (percentage). The mean baseline dmft score was 2.31 ± 1.84 in the intervention group and 2.42 ± 1.91 in the comparison group (table 6). The corresponding

mean DMFT scores were 1.47 ± 1.31 and 1.52 ± 1.36 , respectively. Overall, 88 (66.67%) children had evidence of caries experience at baseline.

Table 6. Baseline Caries Experience According to Dentition Status

Caries Experience	Intervention (n=66)	Comparison (n=66)	Total (N=132)
Mean dmft $\pm$ SD	2.31 ± 1.84	2.42 ± 1.91	2.36 ± 1.87
Mean DMFT $\pm$ SD	1.47 ± 1.31	1.52 ± 1.36	1.50 ± 1.33
Any caries experience	43 (65.15)	45 (68.18)	88 (66.67)
No caries experience	23 (34.85)	21 (31.82)	44 (33.33)

Note: DMFT = Decayed, Missing and Filled Teeth in permanent dentition; dmft = Decayed, Missing and Filled Teeth in primary dentition; SD = standard deviation. At follow-up, the mean dmft was 2.29 ± 1.82 in the intervention group and 2.48 ± 1.94 in the

comparison group ($p=0.574$), shown in table 7. Mean DMFT was 1.50 ± 1.34 and 1.58 ± 1.39 , respectively ($p=0.742$). Caries experience was reported in 39 (65.00%) and 43 (71.67%) participants, respectively ($p=0.436$).

Table 7. Comparison of Caries Experience at Follow-Up Between Study Groups

Caries Outcome	Intervention (n=60)	Comparison (n=60)	p-value
Mean dmft $\pm$ SD	2.29 ± 1.82	2.48 ± 1.94	0.574
Mean DMFT $\pm$ SD	1.50 ± 1.34	1.58 ± 1.39	0.742
Participants with caries experience	39 (65.00)	43 (71.67)	0.436
Participants without caries experience	21 (35.00)	17 (28.33)	0.436

Note: DMFT = Decayed, Missing and Filled Teeth in permanent dentition; dmft = Decayed, Missing and Filled Teeth in primary dentition; SD = standard deviation.

Following the intervention, twice-daily brushing increased from 19 (31.67%) to 47 (78.33%) in

the intervention group (table 8). Fluoride toothpaste use increased from 38 (63.33%) to 55 (91.67%), while appropriate brushing technique increased from 17 (28.33%) to 49 (81.67%). Improvements were comparatively smaller in the comparison group

Table 8. Changes in Selected Oral Hygiene Practices Following the Intervention

Oral Hygiene Practice	Intervention Baseline n (%)	Intervention Follow-up n (%)	Comparison Baseline n (%)	Comparison Follow-up n (%)
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Brushing twice daily	19 (31.67)	47 (78.33)	21 (35.00)	25 (41.67)
Use of fluoride toothpaste	38 (63.33)	55 (91.67)	40 (66.67)	43 (71.67)
Appropriate brushing technique	17 (28.33)	49 (81.67)	18 (30.00)	23 (38.33)
Regular replacement of toothbrush	22 (36.67)	45 (75.00)	24 (40.00)	28 (46.67)
Limiting cariogenic snacks	16 (26.67)	42 (70.00)	18 (30.00)	24 (40.00)

DISCUSSION

The present study showed that there was a definite improvement in oral hygiene after the structured school based oral health education intervention. Of the 120 children who completed follow-up, OHI-S scores decreased from 2.18 ± 0.61 to 1.24 ± 0.49 for the intervention group and 2.21 ± 0.64 to 2.05 ± 0.62 for the comparison group. Change between groups was -0.78 ($p < 0.001$), which reflects significantly higher improvement for the children in the intervention group. The findings align with that of Suresh et al. (2023), who assessed the oral health education intervention among children aged 6 to 12 years and found that there was significant improvement in the oral hygiene outcomes post intervention. The variations in age group are also similar to the previous evidence [13] with school-based delivery.

The findings from the categorical OHI-S also corroborated the improvement seen in the intervention group. The percentage of children who had good oral hygiene grew from 8 (13.33%) to 31 (51.67%) in the intervention group, and from 7 (11.67%) to 10 (16.67%) in the comparison group. Poor oral hygiene decreased from 10 (16.67%) to 1 (1.67%) in the intervention group, compared with 10 (16.67%) to 9 (15.00%) in the comparison group. The findings are consistent with the systematic review and meta-analysis conducted by Stein et al. (2018) who concluded that school-based oral health education has the potential to positively affect oral hygiene outcomes among school children, with effects that differ based on the characteristics of the oral health education intervention and length of its follow-up period [14].

Significant changes were reported in oral-health practices that coincided with the improvement in oral hygiene. In the intervention group, twice-daily toothbrushing

increased from 19 (31.67%) to 47 (78.33%), fluoride toothpaste use from 38 (63.33%) to 55 (91.67%), and appropriate brushing technique from 17 (28.33%) to 49 (81.67%). Limiting cariogenic snacks increased from 16 (26.67%) to 42 (70.00%). In comparison, twice-daily brushing increased only from 21 (35.00%) to 25 (41.67%), while appropriate brushing technique increased from 18 (30.00%) to 23 (38.33%). Yekaninejad et al. (2012) also reported behavioral improvements after a school-based education program (as part of a group-randomized trial) with improved oral-health behaviors and oral-health status, particularly if education was facilitated by the broader school and home environment [15]. The current study also showed a relatively high prevalence of dental caries. A total of 88 (66.67%) children had caries experience. Mean baseline dmft was 2.31 ± 1.84 in the intervention group and 2.42 ± 1.91 in the comparison group, while mean DMFT was 1.47 ± 1.31 and 1.52 ± 1.36 , respectively. At follow-up, mean dmft was 2.29 ± 1.82 versus 2.48 ± 1.94 ($p = 0.574$), and mean DMFT was 1.50 ± 1.34 versus 1.58 ± 1.39 ($p = 0.742$). Therefore, the follow-up caries indices did not show a statistically significant difference between the groups, unlike OHI-S. This result is consistent with the systematic review and meta-analysis by Stein et al. (2018) which indicated that there was more evidence to support positive oral hygiene outcomes than for dental caries after the delivery of oral health education in schools [14].

A lack of a meaningful difference in caries experience in the short term might be because of the cumulative nature of DMFT/dmft indices. With respect to the follow-up caries experience, no difference was found between the intervention and comparison groups, with a score of 39 (65.00%) in the intervention group and 43 (71.67%) in the comparison group at

follow-up ($p=0.436$). For oral health, however, there was a significant improvement within the same three months. This is similar to results in a systematic review of Cooper et al. (2013), which identified "cautious evidence of preventing dental caries" when behavioral interventions were targeted for children in primary schools, and some of the studies they identified showed improvements in plaque outcomes. During their review, they also noted that although behavioural interventions can have an impact on plaque control, this does not always result in an immediate measurable impact on established caries experience [16]. However, the overall results of the present study suggest that the structured school based oral health education program was effective in improving oral hygiene status and oral-health practices in the short-term, while it did not demonstrate a significant effect on DMFT/dmft after three months. The OHI-S improvement (from 2.18 ± 0.61 to 1.24 ± 0.49) and the rise in good oral hygiene (from 13.33% to 51.67%) indicate that oral hygiene education was associated with improvement in oral hygiene. In absence of significant difference in dmft and DMFT however, longer follow-up is possibly required to see if behavioral and hygiene improvements are reflected in measurable reduction in caries experience. This is also in line with the findings by Yekaninejad et al. (2012) that school based interventions have the potential to improve oral-health behaviors and clinical status, and Cooper et al. (2013) who reported that there was little evidence of short term caries prevention through behavior-only school interventions [15,16].

Strengths and Limitations

One of the strengths of this study was the interventional design with baseline and post-intervention clinical assessments that enabled comparisons to be made between children who were assigned to receive structured school based oral health education and those who continued with regular school activities. Objective assessment of oral hygiene and caries experience was achieved using standardized clinical indices (OHI-S and DMFT/dmft), and the same examination procedures were followed at baseline and follow-up. The intervention included repeated education as well as demonstrations and practical advice, and it was possible to evaluate changes in clinical status and oral-health behaviors. However, the study had several limitations. It was implemented in one primary

school only and may not be generalizable to school children in other schools or to other geographical and socioeconomic contexts. A possible limitation is that the intervention and follow-up period were relatively short (3 months) and may not have been long enough to show changes in cumulative caries experience. There may also have been loss of follow up that could have caused attrition bias, and the school-based sampling method might have resulted in limited representativeness. Additionally, some oral health practices involved were based on reported behaviors and may have been influenced by recall or social desirability bias. More long-term, multi-site clinical research with larger samples, longer follow-up and uniform preventive practices is recommended to evaluate the long-term impact of school-based oral health education.

CONCLUSION

Oral health education that is structured in schools was found to have significant oral health outcomes for primary school children in terms of oral hygiene status and oral-health practices. The results justify the importance of schools as a place to provide structured oral health promotion and reinforce good toothbrushing, fluoride toothpaste use, toothbrushing technique, and dietary habits. The short follow-up time, however, did not show statistically significant impact on cumulative dental caries experience. Oral health education in schools should thus be viewed as an essential component of preventive oral health promotion; longer-term programs, with additional reinforcement and other proven preventive strategies, may be necessary to gauge the long-term impact on dental caries.

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