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Effect of an Oral Health Promotion Program Including Supervised Toothbrushing on 6 to 7-Year-Old School Children: A Randomized Controlled Trial

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A B S T R A C T

Objectives: The purpose was to evaluate the impact of an oral health promotion program including supervised toothbrushing and educational packages for parents on parent's knowledge and oral health status of 6- to 7-year-old schoolchildren.

Materials and Methods: A multi-stage cluster random sampling method was applied, and schools were allocated to intervention and control groups. After ethical clearance and baseline evaluation, an intervention package consisting of supervised toothbrushing at the school setting, an educational package for parents, and a home package containing toothbrush and fluoridated toothpaste (1000 parts-per-million) were delivered. A post-intervention evaluation was performed after one month on parents' oral health knowledge and oral hygiene of children using the Oral Hygiene Index Simplified (OHI-S). Schools were considered as a unit of randomization, and a generalized estimating equation (GEE) analysis was performed to apply the cluster effect. Descriptive and analytical analyses were performed using SPSS 22 software.

Results: Overall, 701 subjects were re-examined (response rate of 95%). At the one-month follow-up, being in the intervention group (P<0.001, B=-0.028, 95% confidence interval (CI)=-0.33, -0.23) and having higher socioeconomic status [P=0.01, B=-0.12, 95% CI=-0.22, -0.03) were significantly associated with improved oral hygiene status. In the post-test evaluation, parents' knowledge improvement score regarding oral health in the intervention group was not statistically different from that of the controls (0.51 vs. 0.23). However, the ΔOHI-S improved in the post-test evaluation (-0.27±0.02 vs. 0.02±0.02; P<0.001).

Conclusion: Children showed improved oral hygiene status, as measured by the OHI-S, after the program consisting of supervised toothbrushing.

Keywords: Child; Schools; Health Education, Dental; Toothbrushing

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INTRODUCTION

Oral health of schoolchildren can be promoted in the school settings through various oral health promotion programs. Supervised toothbrushing programs have been shown as one of the beneficial programs. Supervised toothbrushing, as defined in a study by Dos Santos et al [1], describes "an adult person actively brushing a child's teeth or an adult supervising a child while the child is brushing their teeth". Also, it may include supervision of toothbrushing at a dental setting by a dental

professional or at school by a teacher in addition to home-based methods including parental-supervised toothbrushing [1].

Previous studies show that promoting oral health at earlier ages can lower the costs and be more sustainable. As child health behaviors shape and establish between the ages of 5 and 8 years old, schools are considered a suitable environment for promoting oral health. Twice daily brushing at home is considered optimal; however, most children refuse to do so. School-based interventions, such as supervised toothbrushing and educating parents, can help the better establishment of this behavior in children [2]. The advantage of supervised toothbrushing is the education of the correct method of toothbrushing in addition to receiving sufficient fluoride [1].

In 2015, Petersen et al [3] showed that implementing an interventional program comprising supervised toothbrushing for children after lunch, providing oral health education to children, and communicating with teachers and parents/caregivers about improving children's oral health can significantly improve the oral health of children. In 2013, Jurgensen and Petersen [4] reviewed the range of school-based strategies to improve oral health. This survey revealed that schools could provide a supportive environment for promoting children's health [4].

The review study by Nakre and Harikiran [5], in 2013, showed that oral health education programs are effective, especially when teachers and parents are involved and an oral prophylaxis component is included.

Oral health promotion programs are important in the age of eruption of the first permanent molars.

Accordingly, more specific techniques for brushing of the first permanent molars have been emphasized. In 2011, Frazão [6] conducted a randomized controlled trial in a Brazilian low-income fluoridated area. The incidence of caries was 50% lower in the intervention group compared to the control group, especially among boys and in those more vulnerable [6].

In a local study performed by Yekaninejad et al [7], a health promotion program for increasing the frequency of toothbrushing and flossing was performed on three groups, including the comprehensive group (children, their parents, and school teachers), the students group (only children), and the controls (no intervention).

In this study, a significant improvement in oral health behavior (brushing and flossing) was observed among children in the comprehensive group [7].

There is scarce information about the effectiveness of the supervised cross-brushing technique in schoolchildren in developing countries. This study aimed to evaluate the impact of an oral health promotion program including supervised toothbrushing on parent's knowledge and oral hygiene status of 6- to 7-year-old schoolchildren.

MATERIALS AND METHODS

This study is a short-term assessment of the outcomes of a community-based randomized controlled trial, which evaluates the effect of oral health education of parents on the oral health status of 6- to 7-year-old children in Tehran, Iran.

Sampling:

A multi-stage cluster random sampling method was applied in different regions of Tehran according to the map of the Ministry of Education (19 districts). The sample size was adjusted according to the socioeconomic status, considering affluent (1 to 8) and non-affluent areas (9 to 19) as strata. In each stratum, three districts were randomly selected, and in each district, four schools, including two girls' and two boy's schools, were chosen as units of intervention and control. The participants and the statistician were blind to the allocation of the groups [8]. The sample size was calculated as 720 subjects, 360 subjects in each group (α=0.05, power of 80%, and the design effect of 1.5). Ethical clearance was sought from the Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran (IR.TUMS.REC.1394.1730). The trial has been registered on the IRCT website (reference number: IRCT20090307001749N4). The protocol and the objectives of the study were

explained to study subjects in a simple language, and informed consent was sought. The outline of the study is presented in Figure 1. Eligibility criteria for recruiting subjects were defined. Healthy 6- to 7-year-old children with signed parents' consent forms were included in the study. Children with an allergy to fluoride, physical disability, systemic diseases or a dental emergency were excluded.

Data collection:

A validated questionnaire containing 9 questions on oral health knowledge was used [9]. A questionnaire was applied to collect data on socio-demographics and oral health knowledge. Demographic variables included age, gender, father's education, mother's education, birth order, and the number of children in the household [8]. Clinical examination was performed in the classroom by a calibrated examiner using a headlamp, and the Oral Hygiene Index Simplified (OHI-S) was recorded [10]. Subjects were examined in a seated position, and disposable instruments were used to record the index under a headlamp. The OHI-S was applied to measure the oral hygiene status.

After the baseline evaluation, the intervention package was delivered to the intervention group, following coordination with school officials. The intervention package consisted of supervised toothbrushing at the school setting and a free package containing home supplies of toothbrush and fluoridated toothpaste (1000 parts-per-million (ppm)]. In addition, a training session was organized for parents (mostly mothers), class teachers, and health instructors, which was delivered at the school setting by the main investigator (AB) after coordination with the professional colleague (AP).

In the session, a PowerPoint presentation was delivered containing the comparison of primary and permanent teeth (eruption time), the importance of the first permanent molar teeth, dental plaque and dental caries, fluoride therapy, nutrition, preventive oral health, fissure sealant, dental visit, and follow-up (Box 1). A recommended technique for brushing of newly erupted permanent molars was presented with emphasis on the buccolingual technique [6] using demonstration and educational videos.

At the end of the session, a pamphlet was delivered to parents, which contained the content of the training session to take home. For children at the school setting, a practical session on supervised toothbrushing was held under the supervision of the researchers and volunteer parents. Instruction and home supplies were provided to parents to be followed at home. After one month, a post-test evaluation consisting of a questionnaire survey on oral health-related knowledge was performed, and clinical data on oral hygiene status (OHI-S) were collected.

Statistical analysis:

The frequency distribution of true/false answers for each knowledge question was scored, and the sum score of oral health knowledge (9 questions) was calculated. In the post-test evaluation, the mean scores for oral health knowledge and the OHI-S were assessed.

The changes in the level of knowledge and oral hygiene status (Δ) were considered as the primary outcomes; two different measurements were made at the baseline and the one-month follow-up. A linear regression analysis was performed to assess the impact of independent variables, including gender, belonging to the intervention group, parent's education, birth order, the number of children, change of knowledge of parents (Δ), and oral hygiene improvement (Δ) at post-evaluation compared to the baseline. In the final analysis, missing answers in the questionnaire were replaced.

To evaluate the impact of cluster analysis, a generalized estimating equation (GEE) test with an exchangeable correlation matrix was used to assess the effect of the intervention on participants' oral health knowledge and oral hygiene (OHI-S) between the control and intervention groups at the one-month follow-up. In this analysis, the class (school) was defined as "subject" and the student ID as "Within-subject".

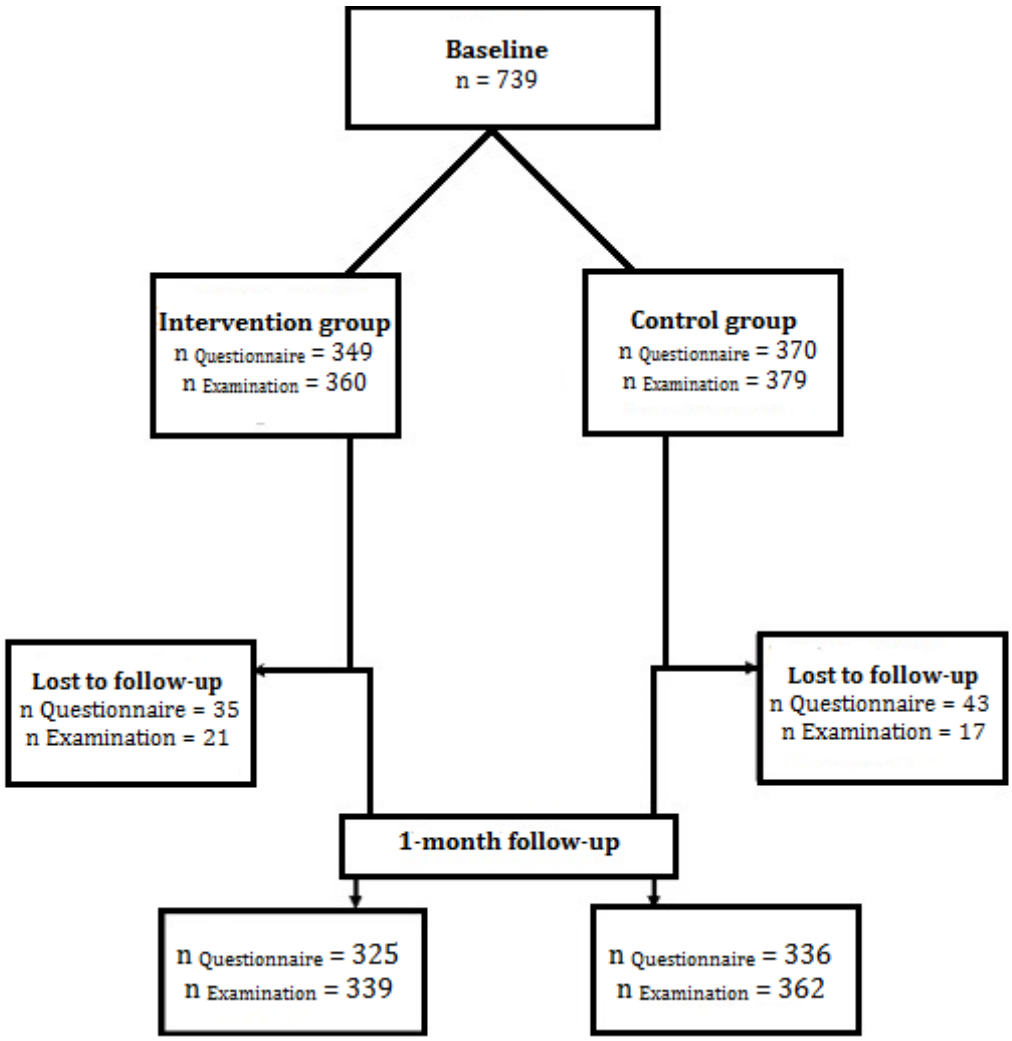

Fig. 1. Flowchart of the study participants at the baseline and at the post-test evaluation

The grouping variable (control vs. intervention) was considered as an independent variable considering the "Predictor". The Statistical Package for Social Sciences (SPSS version 22.0; SPSS Inc., Chicago, IL, USA) was used for data analysis, and the significance level was set at 0.05.

RESULTS

Of the 739 subjects at the baseline, 701 were re-examined at the one-month follow-up, except those participants that were absent or did not have informed consent in the post-test evaluation (Figure 1). Socio-demographic characteristics of the study participants, including gender, father's education, mother's education, birth order, the number of children in the household, supervised toothbrushing by parents, and socioeconomic status, were comparable between the intervention and control groups at the baseline. In addition, at the baseline, the oral hygiene status of children (OHI-S) were measured as the sum score in the intervention group compared to the controls (0.49±0.39 vs. 0.48±0.37). Also the level of parents' knowledge was measured as the sum score of the nine questions compared between the intervention and control groups (6.8±1.9 vs. 7±1.6). Overall, 701 subjects were re-examined at the one-month follow-up. The linear regression analysis revealed that being in the intervention

group (P<0.001, B=-0.028, 95% confidence interval (CI)=-0.33, -0.23) and having higher socioeconomic status (P=0.01, B=-0.12, 95% CI=-0.22, -0.03) were significantly associated with improved oral hygiene status as measured by the ΔOHI-S presented in Table 2.

Table 1. Socio-demographics and oral hygiene status of study subjects in the control and intervention groups at the baseline

	Control		Intervention	
	N	(%)	N	(%)
Gender (n=739)				
Boy	183	48.3	176	48.9
Girl	196	51.7	184	51.1
Father's Education (n=693)				
Illiterate/Elementary school[1]/Middle school[2]	57	16.1	57	16.9
High school or Diploma[3]	131	36.9	141	41.7
Associate[4]/Bachelor/Master's of science/Doctorate	167	47	140	41.4
Mother's Education (n=694)				
Illiterate/Elementary school[1]/Middle school[2]	45	12.8	52	15.2
High school or Diploma[3]	153	43.5	152	44.4
Associate[4]/Bachelor/Master's of science/Doctorate	154	43.8	138	40.4
Birth order (n=633)				
First	197	61.8	194	61.8
Second	99	31	96	30.6
Third	20	6.3	22	7
Forth and more	3	0.9	2	0.6
Number of children in the household (n=684)				
1	128	37.1	124	36.6
2	170	49.3	179	52.8
3 and more	47	13.7	38	10.6
Supervised toothbrushing by parents (n=709)				
Not supervised	155	42.8	139	40.1
Supervised	207	57.2	208	59.9
Socioeconomic status[5] (n=549)				
Less than 20	117	46.4	134	45.1
Equal or more than 20	135	53.6	163	54.9

[1] 5 years; [2] 6-8 years; [3] 9-12 years; [4] Two years of academic education; [5] Housing area (m^2 per person)

Table 2. Linear regression analysis of the impact of oral health knowledge and demographic variables on oral hygiene change (Δ OHI_S)

	Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
	B	**Std. Error**	**Beta**	**t**	**P-value**	**Lower**	**Upper**
Gender							
Boy	Ref						
Girl	-0.03	0.03	-0.04	-0.95	0.34	-0.08	0.03
Group							
Control	Ref						
Intervention	-0.28	0.03	-0.46	-10.32	0.00	-0.33	-0.23
Father's Education							
Illiterate/Elementary school[1]/Middle school[2]	Ref						
High school or Diploma[3]	0.02	0.02	5.27	1.41	0.16	-0.01	0.06
Associate[4]/Bachelor/Master's of science/Doctorate	-0.02	0.02	-5.24	-1.4	0.16	-0.06	0.01
Mother's Education							
Illiterate/Elementary school[1]/Middle school[2]	Ref						
High school or Diploma[3]	-0.01	0.04	-0.02	-0.3	0.76	-0.1	0.07
Associate[4]/Bachelor/Master's of science/Doctorate	0.07	0.05	0.11	1.41	0.16	-0.03	0.16
Child birth order							
First or Second	Ref						
Third & more	0.00	0.00	-0.01	-0.32	0.75	0.00	0.00
Number of children in the household							
1 and 2	Ref						
3 and more	-0.03	0.04	-0.03	-0.7	0.46	-0.12	0.05
Socio-economic status[5]							
Less than 16.5	Ref						
Between 16.5-33	-0.04	0.03	-0.07	-1.42	0.16	-0.11	0.02
More than 33	-0.12	0.05	-0.14	-2.62	0.01	-0.22	-0.03
Supervised tooth brushing by parens							
Not supervised	Ref						
Supervised	0.00	0.02	0.00	0.54	0.96	-0.03	0.03
ΔKnowledge (9Qs)	-0.00	0.01	-0.02	-0.35	0.73	-0.02	0.01

Hygiene change (ΔOHI-S); Dependent Variable: ΔOHI_S; [1] 5 years; [2] 6-8 years; [3] 9-12 years; [4] 2 years of academic education; [5] Housing area (m^2 per person)

After missing imputation and considering schools as clusters, the results of the GEE analysis showed that the changes in the scores of oral health knowledge (Δ) at the one-month follow-up were not statistically significant in the intervention group compared to the controls (0.51±0.22 vs. 0.23±0.11). However, the OHI-S improved in the post-test evaluation in the intervention group compared to the controls (-0.27±0.02 vs. 0.02±0.02; P<0.001; Table 3).

Table 3. Generalized estimating equation analysis of oral health knowledge and oral hygiene status of children (OHI-S) after the intervention. Values are expressed as Mean±Standard Error

	Intervention group	Control group	P-value
Oral health knowledge	0.51±0.22	0.23±0.11	0.26
OHI-S	-0.27±0.02	0.02±0.02	<0.001

OHI-S: Oral Hygiene Index Simplified

DISCUSSION

This is a community-based randomized controlled trial, which reported the short-term effect of a health promotion program including educating parents and supervised toothbrushing. In this study, we assessed the OHI-S of children and parents' knowledge regarding oral health before and after the educational intervention. Considering the cluster effect, the GEE analysis showed that oral hygiene status was significantly improved. The improvement of parents' oral health knowledge was not significant in the final analysis when comparing the intervention and control groups. The oral hygiene status of children in the intervention group significantly improved according to the OHI-S. In a systematic review in 2018, Stein et al [11] reported the impact of oral health education interventions on oral hygiene levels. This meta-analysis showed that there is a significant improvement in the plaque index according to the Loe and Silness and O'Leary indices after short-time educational interventions [11].

This is in line with the results of a study by Saied-Moallemi et al [9] in 2009, which showed an improvement in the oral health outcomes among 9-year-old children after an educational intervention.

There is a need to educate parents in developing countries, especially regarding the age group that is transitioning from the primary to the permanent dentition. Our findings showed that oral health knowledge of parents was not significantly improved following the intervention though the level of knowledge was acceptable at the beginning of the study. In 2016, Sehrawat et al [12] reported a poor level of knowledge of Indian mothers regarding the oral health of preschool children. We conducted a workshop to transfer oral health knowledge to parents. This is in line with the recommendation of the World Health Organization (WHO) for communicating with parents [13]. Our study showed that oral health education programs that targeted schoolchildren and home settings were more promising. This finding is in line with a review study by Stein et al [11] and the study by Petersen et al [3].

We delivered a comprehensive educational package to the intervention group, which consisted of several parts. The main component of this package was supervised toothbrushing at the school setting. A home package including free toothbrush and fluoridated toothpaste (1000 ppm) was also delivered to be used by the parents at home. Cooper et al [2] stated that school-based interventions, such as supervised toothbrushing, could help children and their parents to preserve oral health. In a systematic review by Dos Santos et al [1], the effect of supervised toothbrushing on caries incidence was assessed. The results reported some positive effects of providing children with school-supervised toothbrushing [1].

In our study, the GEE analysis was used considering schools as a cluster. This is in line with a study by Haleem et al [14], which used the GEE analysis to justify the clustering effect. This method was used in a previous local study by Gholami et al [15] to assess the effect of a media campaign on oral health knowledge. In the present study, families with better

socioeconomic status showed significant improvement in oral hygiene status. A similar finding was observed in an Indian study, which reported that children with upper-middle and lower-middle socioeconomic status exhibited a significant improvement in oral hygiene habits [16]. In the current study, a representative sample consisting of a multistage cluster random sample across the city of Tehran was used. A valid questionnaire was used to assess the parents' level of knowledge. The examiners were calibrated, and few subjects were lost to the post-intervention follow-up after one month. Our interventional package was multidimensional, consisting of several parts, including supervised toothbrushing at the school setting, brochures, and home supply. Our study has some limitations including our restricted control on the parents' supervision at home. On the other hand, not all parents could attend the educational session. We assessed short-term data after one month; however, the improvement of oral health outcomes should be reevaluated in longer intervals.

CONCLUSION

This study showed the short-term impact of an oral health promotion program, including supervised toothbrushing and educating parents, on the oral health status of primary school children. Children in the intervention group showed better oral hygiene improvement after one month as measured by the OHI-S.

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CONFLICT OF INTEREST STATEMENT

None declared.

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