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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_619_19

Effectiveness of a curriculum-based educational intervention on oral health behavior and dental caries experience among Indian schoolchildren

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Abstract:

BACKGROUND: The high incidence of dental diseases among Indian children can be attributed to low awareness regarding the oral health maintenance. The school health curriculum in India is deficient of an oral health component, and there are no organized oral health programs for schoolchildren existing at present. Therefore, the present study was conducted to assess the effectiveness of an oral health curriculum in improving the oral health behavior and dental caries experience in schoolchildren.

METHODS: A nonrandomized trial with pretest/posttest design was conducted among 600 schoolchildren. Two intervention arms were designed with one group receiving health education from a dental health professional and other from a school teacher. The oral health curriculum was customized for three sections of different age groups (lower primary [LP], upper primary [UP], high school [HS]) and implemented for a period of 1 year. Oral health behaviors were recorded using a Knowledge, Attitude and Practice (KAP) questionnaire and were evaluated at baseline, 6 months, and 1 year of the educational intervention. Dental caries experience was measured Pre and Post - intervention using deft and decayed, missing, and filled teeth indices. Descriptive statistics were calculated for continuous data, and the change in KAP scores and dental caries experience was analyzed using the repeated measures of ANOVA, independent *t*-tests, and paired *t*-tests.

RESULTS: There were significant improvements in KAP regarding oral health among Indian schoolchildren. Significant reductions in decayed primary teeth were observed in LP and UP schoolchildren post-intervention. However, there was no significant difference in primary outcome between the two intervention arms.

CONCLUSIONS: A curriculum-based health education intervention customized for different age groups was found to be effective in improving oral health behavior and dental caries experience among Indian schoolchildren.

Keywords:

Children, dental caries, health education, oral health behavior

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Received: 17-10-2019
Accepted: 22-12-2019
Published: 28-04-2020

Introduction

India with its high population growth rate faces many challenges in delivering its oral health needs. Since 1940, the prevalence of dental caries in 5-year-old and 12-year-old schoolchildren in India has been steadily increasing.^[1] A large number of children and their parents in this country lack the

knowledge about the prevention of the most common oral diseases. A study reported that oral health knowledge among Indian children was low when compared to their Western counterparts.^[2]

To improve oral health worldwide, promoting oral health of children through health promoting schools (HPS) has been prioritized

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How to cite this article: Karuveetil V, Kumar SV, Janakiram C, Joseph J. Effectiveness of a curriculum-based educational intervention on oral health behavior and dental caries experience among Indian schoolchildren. *J Edu Health Promot* 2020;9:90.

by the World Health Organization.^[3] The initiative helps countries to develop strategies and collaboration between health and education agencies to improve health through schools.^[4] One of the key components of a HPS is health education. Oral health education can be taught as a specific subject or as part of other subjects, addressing the underlying physical, psychological, cultural, and social determinants of oral and general health. It can be effective in increasing the knowledge, improving the gingival health^[5] in the short term and to some extent, achieving favorable behavior such as tooth brushing and healthy eating in the long run.^[6]

After the introduction of the HPS concept, many countries are delivering health education in a curriculum format. An oral health curriculum consists of a gradual and increasing incorporation of basic information on oral health into the regular health curriculum of schools. The curriculum is generally imparted by school teachers, and hence, the content is designed in pedagogy format with specific learning objectives, assessment, and targets. State dental associations are taking up the role of initiating and implementing oral health curriculum in their respective states in Western countries. The curriculum is usually designed by a team of dentists and educationists according to a need-based framework.^[7] An oral health curriculum developed by combining national curriculum guidelines of the United Kingdom with oral health education messages has found to equip children with knowledge which enables them to make informed choices about the way they lead their lives and maintain their oral health.^[8]

An oral health curriculum progresses from preschool when children are under the control of parents, proceeding through elementary and middle school. It culminates at the high school (HS) when students are becoming young adults with ability to make decisions for them thereby. There are modules developed for each grade with age-appropriate material which can be covered according to the agreed upon schedule with the school authority. The topics covered in an oral health curriculum is based on tooth decay, oral hygiene, fluoride, nutrition, schedule of dental visits, and injury.^[9]

A curriculum-based health education could be effective in altering the behavior of children in a positive way and could bring down the dental caries burden. The school health curriculum in India lacks an oral health component; therefore, a multipronged and multilevel public health intervention integrating oral health into the school curriculum beginning from early schooling is of import. Hence, this study was designed with the aim to test the effectiveness of an oral health curriculum on oral health behavior and dental caries experience among Indian schoolchildren.

Methods

Study design

A nonrandomized controlled trial with parallel arm was adopted. Randomization was not logistically possible due to the nature of the interventions. The intervention arm and the control arm were comparable at baseline as revealed by the independent *t*-test analysis accounting for age, gender, socioeconomic status, and parental occupation.

Study setting and population

The present study was conducted among schoolchildren in a private school following CBSE curriculum from June 2017 to June 2018 and was categorized as lower primary (LP) (Standard 1–4), upper primary (UP) (Standard 5–7), and High School (HS) (Standard 8–10) sections. The study had two intervention arms. A cluster of one division from each standard was taken as Group A (Instructor A – oral health curriculum imparted by dentist) and the other division as Group B (Instructor B – oral health curriculum imparted by school teacher).

Sample size of 600 was obtained based on a pilot study with 95% confidence interval and 80% power with an expected attrition rate of 20%. Students who failed to give assent and those without parental consent were excluded from the study.

Outcome assessment

The primary objective was to assess the knowledge, attitude, and practice (KAP) regarding oral health and three different questionnaires were developed for three sections of schoolchildren based on the oral health curriculum in the English language. The questionnaire contained closed-ended questions assessing sociodemographic characteristics along with children's knowledge of oral health, attitude regarding the importance of oral health and oral hygiene practices adopted by them. Reliability of the questionnaire was assessed by test-retest method during the pilot study, and the kappa statistics values were satisfactory. The deft (aggregate of decayed, extracted, and filled teeth in the primary dentition) and DMFT (aggregate of decayed, missing and filled teeth in the permanent dentition) indices were recorded to assess the dental caries experience as per the WHO survey methods.^[10]

Interventions and organizing the study

The present study was organized in five phases, and necessary permissions were obtained [Figure 1]. Ethical approval was obtained from the Institution Review Board. The trial was registered with the Clinical Trial Registry of India (Registration number CTRI/2018/01/011407).

Phase 1: Preparatory phase

The oral health curriculum was developed

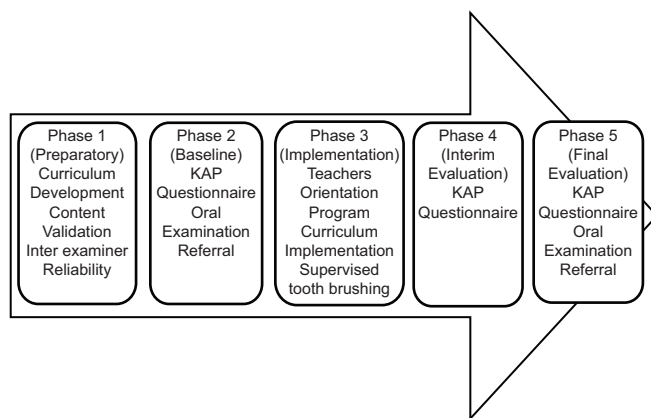


Figure 1: Phases of organizing the study

based on a six-step approach by Thomas *et al.* in 2016.^[11] The curriculum material had four modules with age-appropriate instructions for different sections of schoolchildren. Each module had lesson plans with instructions for the educator, hands-on demonstrations, handouts, or master copies for each child to be distributed after each session. The handouts contained information on healthy teeth, primary and permanent dentition, tooth brushing, parts of tooth, chemistry of decay, fluorides, flossing, dental visits, tobacco habits, trauma management, and nutrition. Instructor's information booklet was attached with the curriculum to give detailed information regarding causation, identification, and prevention of various orodental problems which will also suit school teachers who are new to this subject.

The content validation form was prepared with a comment option for each lesson plan and was send to five experts in the field. The content validation index obtained was 0.60 which was adequate. To eliminate the inter-examiner variability for recording clinical examination (dental caries) and KAP questionnaire, kappa statistic exercises were performed between different examiners. On achieving kappa score of more than 90% only, the examiners were allowed to perform the clinical examination.

Phase 2: Baseline examination

Baseline survey was conducted for preintervention data analysis. The survey included KAP questionnaires and oral examination performed by trained dental professionals. For grades 1–4, investigators explained the questions to each participant, and the responses were recorded. In higher grades, participants were distributed KAP questionnaire and were familiarized with the contents and how to fill it. The dental surgeons carried out the clinical examination of the children using mouth mirrors and explorers under standard aseptic conditions in broad daylight. For information of parents, an oral health checkup card was also given

to the children denoting the dental treatments required with a referral letter.

Phase 3: Implementation of oral health curriculum

Teacher's orientation program was conducted where the teachers were made familiar to the curriculum by giving detailed explanation of different conditions involving oral health expected in the schoolchildren. The principal investigator (Dentist) imparted the oral health curriculum for Group A. For Group B, school teachers of respective grades who had volunteered to take part in the study imparted the lessons. Same educational materials and models were used by both dentist and teacher thus ensuring the uniformity. Each grade received one session every 4 months and reinforcements for each session were given in the next session. A supervised tooth brushing activity was conducted for LP children. A reinforcement session was given after final questionnaire administration.

Phase 4: Interim examination

After 6 months of implementation phase, an interim evaluation in the form of a KAP survey using the same questionnaire was conducted among all students. For HS children, this was not conducted due to their academic schedules.

Phase 5: Final examination

After 1 year of implementing the curriculum, the children were re-evaluated. The final clinical examination and KAP questionnaire recording was performed in the same manner as baseline evaluation. An extra visit to account for absentees was also performed.

Statistical details

To test the statistical significance of the change in KAP for oral health curriculum across time periods in each group, repeated measures ANOVA was used in LP and UP schoolchildren. For HS children, the paired *t*-test was used to arrive at an inference. Comparison of overall KAP scores between dentist and teacher in different sections of schoolchildren was analyzed using the independent *t*-test. For the comparison of overall KAP scores between three sections at different time intervals regardless of health educator, repeated measures ANOVA was used for LP and UP schoolchildren, and for HS children, paired *t*-test was applied. In case of statistical significance, Bonferroni multiple comparison *post hoc* test was applied.

Results

A total of 480 students completed all three evaluations after 20% drop out. The mean age of the study population was 7.40 ± 1 ; 11 years for LP schoolchildren, 10.76 ± 0.97 years for UP schoolchildren, and 13.82 ± 0.9 years for HS children.

When analyzing the oral health behavior using KAP questionnaire, the impact of oral health curriculum varied across different sections. The mean knowledge and attitude scores showed a statistically significant increase across all the time periods, t_0 (baseline) to t_6 (at 6 months) to t_{12} (at 12 months) for LP schoolchildren. In UP school, an increase in attitude and practice scores between the time periods of t_0 versus t_6 and t_{12} versus t_0 was noted with statistical significance ($P < 0.005$). While among HS children, an increase in mean KAP scores was noted when comparing t_0 versus t_{12} , but the paired t -test revealed no statistical significance [Table 1].

When comparing overall KAP scores between instructor A and B regardless of sections, higher scores were noted for knowledge, attitude, and total KAP scores for instructor A. The practice scores were higher for instructor B. However, the independent t -test revealed no statistical significance between instructor A and B in the comparison [Table 2].

When comparing caries experience in deciduous dentition of LP children, the mean deft of 2.50 ± 2.78 was noted at baseline, which following

intervention, decreased to 1.67 ± 2.22 with statistical significance ($P < 0.001$). In permanent dentition, the mean DMFT score from baseline to postintervention showed an increase of 0.25 ± 0.54 . In UP children, a mean deft of 0.70 ± 1.35 at baseline decreased to 0.32 ± 0.85 postintervention with statistical significance ($P < 0.001$). The mean DMFT at baseline was 0.68 ± 1.14 which increased to 0.80 ± 1.36 postintervention. The average deft for HS children was 0.04 ± 0.36 at baseline and it reduced to 0.02 ± 0.20 postintervention. The total DMFT score was 0.98 ± 1.69 at baseline which decreased to 0.75 ± 1.51 at the final examination. However, these differences failed to reach statistical significance [Table 3].

Discussion

The present study was carried out to test the effectiveness of an oral health curriculum in improving oral health knowledge, attitude, practice, and dental caries experience among two intervention arms with a dental health professional and schoolteachers imparting oral health education. The intervention arms were made comparable at baseline controlling the sociodemographic

Table 1: Comparison of knowledge, attitude, and practice scores across time periods among three sections of schoolchildren

Between time periods	Lower primary (mean difference) (n=201)			Upper primary (mean difference) (n=148)			High school (mean difference) (n=131)
	t_6-t_0	$t_{12}-t_6$	$t_{12}-t_0$	t_6-t_0	$t_{12}-t_6$	$t_{12}-t_0$	$t_{12}-t_0$
Knowledge	0.517 (0.26-0.77*)	0.289 (0.57-0.52*)	0.806 (0.56-1.05*)	0.007 (-0.22-0.24)	0.088 (-0.10-0.28)	0.095 (-0.14-0.33)	0.162 (-0.03-0.36)
Attitude	0.950 (0.70-1.19*)	0.407 (0.24-0.57*)	1.357 (1.12-1.59*)	0.466 (0.25-0.68*)	-0.068 (-0.23-0.10)	0.399 (0.17-0.63*)	0.069 (-0.07-0.21)
Practice	0.050 (-0.17-0.27)	0.000 (-0.22-0.22)	0.050 (-0.16-0.26)	0.527 (0.23,0.83*)	0.027 (-0.28-0.33)	0.554 (0.26,0.85*)	0.138 (-0.13-0.41)

For LP and UP, repeated measures ANOVA was applied, * $P < 0.05$. For HS, Paired t -test was applied. LP=Lower primary, UP=Upper primary

Table 2: Comparison of overall knowledge, attitude, and practice between teacher and dentist regardless of the sections

Variables	Dentist (Group A) overall mean scores (n=252)	Teacher (Group B) overall mean scores (n=228)	Mean difference (Group B mean score-Group A mean score)
Knowledge assessment	3.41±0.29	3.41±0.25	-0.0067 (-0.60-0.62)
Attitude assessment	4.40±0.22	4.29±0.21	-0.1033 (-0.39-0.60)
Practice assessment	2.93±0.40	2.94±0.53	0.0133 (-1.08-1.06)
Total KAP assessment	10.74±0.60	10.64±0.60	-0.0933 (-1.25-1.44)

Independent t -test, * $P < 0.05$. KAP=Knowledge, attitude, and practice

Table 3: Comparison of dental caries experience pre- and post-intervention among three sections of schoolchildren

Time	Dental Caries Experience	Lower primary (n=201)	Upper primary (n=148)	High school (n=131)
Preintervention (t_0)	Mean deft	2.50±2.78	0.70±1.35	0.04±0.36
	Mean DMFT	0.15±0.51	0.68±1.14	0.98±1.69
Postintervention (t_{12})	Mean deft	1.67±2.22	0.32±0.85	0.02±0.20
	Mean DMFT	0.18±0.51	0.80±1.36	0.75±1.51
Mean difference ($t_{12}-t_0$)	Mean deft	-0.83±1.95 (0.56-1.10*)	-0.39±1.10 (0.20-0.56*)	-0.015±0.41 (-0.09-0.06)
	Mean DMFT	0.25±0.54 (-0.10-0.05)	-0.10±1.33 (-0.11-0.32)	-0.22±1.69 (-0.07-0.51)

Paired t -test, * $P < 0.05$. DMFT=Decayed, missing, and filled teeth

variables which could be potential confounders in oral health education.^[12]

From the results of the KAP questionnaire, pre- and post-evaluation, it could be concluded that overall, the KAP scores have improved across time periods in all sections of schoolchildren in both the intervention groups. However, there were variations when comparing interim evaluation for different sections.

In LP children, knowledge regarding milk teeth, symptoms of tooth decay, diet causing dental caries, and brushing habits has improved significantly across different time periods. Attitude about maintaining oral health, effect of oral health on general health, tooth brushing as a means to prevent tooth decay, and keeping mouth clean after eating sticky foods has also been seen to improve across time periods. The age of the LP children ranged from 5 to 10 years, indicating that children as young as age 5 are receptive to oral health education which can positively influence and improve their oral health knowledge and attitude. Five years of age can be considered apt for introducing children to oral health care as this is the age after which permanent teeth starts erupting, with all the deciduous teeth in place. At this age, major dental diseases can be prevented by delivering key behavioral messages related to oral health, including brushing twice daily with fluoride toothpaste and curbing the consumption of sugary foods and the resulting practices which the children can adhere to thereafter.^[13] Majority of the studies focus on children aged above 10 years as there is a preassumption that children of lower grades cannot grasp or comprehend the oral health education in India. Very few studies have included children below 10 years showcasing an improvement in oral health behavior and practice.^[14-16]

In UP children, a significant improvement in attitude and practice was noted across time periods. This age group includes the global monitoring age of 12 years and majority of the health education interventions are concentrated around this age. One of the important reasons being at this age, the children can be influenced to develop and maintain good oral hygiene practices which is the ultimate aim of an oral health education.^[17-19] A significant improvement was noticed regarding the frequency and duration of tooth brushing, frequency of changing toothbrush, use of fluoridated toothpaste, reducing consumption of sweets, and dental visits in this age group.

Educational interventions can influence health-seeking behavior and can bring about favorable health outcomes. Through oral health education, one of the objectives is to bring down dental caries experience. This is achieved through preventing the development of new carious

lesions and treating the already decayed teeth either by restoration or extraction. There was a significant reduction in deft scores postintervention in UP and LP children which does reflect the positive effect of curriculum-based oral health education.

Intersectoral collaboration between dental health professionals, health centers, and school teachers provides an opportunity to establish a referral system, through which timely and adequate intervention can be ensured.^[20] A good referral system was set up for children requiring dental treatments; this could have led to the extraction of decayed deciduous teeth which could be one of the reasons of reduced deft. However, we cannot attribute this reduction completely to the effect of oral health education, as this is also the age at which the exfoliation of deciduous teeth occurs. This could have been a potential confounder as young children are prone to recall bias when assessing teeth extracted due to caries.

There are only few studies available where a significant reduction in dental caries of permanent dentition was observed post oral health education^[16,21-23] and a couple of these studies had long-term follow-up.^[22,23] Conversely, oral health education could not bring a significant effect on dental caries experience in permanent dentition even with reduction in decayed teeth and improvements in the number of filled permanent teeth, as reported in the systematic reviews conducted by Kay and Locker^[6] and Stein *et al.*^[24] The present study also has similar findings which can be justified by the study duration of 1 year which is too short a time to bring about changes in caries experience of permanent dentition.

There is an uncertainty in imparting of oral health education as to who is the ideal person to teach schoolchildren about oral health. Many studies have shown personnel from different disciplines administering the oral health education such as dentists, school teachers, dental students, and Anganwadi workers in India. In the present study, the oral health education was imparted by a dentist and a school teacher, and the effectiveness was evaluated and compared based on KAP scores. The KAP scores when compared between the two groups showed no significant changes, suggesting oral health curriculum delivery can be multidisciplinary. A similar study was conducted in Maharashtra^[25] where a comparison was made between the effectiveness of health education delivered by a schoolteacher and dentist which failed to reach significant differences.

Effectiveness of oral health education on schoolchildren is a much-researched topic. However, for comparison purpose, it holds inappropriate as there are wide variations in the content of education module and the method with which it is imparted. Every country has

different oral health curriculum modules developed by dental associations, and there are variations among different states too. India does not have an oral health curriculum yet and the oral health education for schoolchildren is conducted by dental colleges for a short duration of 1 to 2 hours without reinforcements. Therefore, an oral health curriculum with proper planning and scheduling is much needed in the Indian health education scenario. For further research, it is recommended to follow a common educational module which can be translated into different regional languages and applied in different population settings.

Conclusions

Oral health curriculum was found to be effective in improving oral health behavior and dental caries experience among Indian schoolchildren. This signifies the potential value of schoolchildren as targets for health messages to control oral diseases and to create the awareness about the prevention of oral diseases which should be started at a younger age. The gradual and increasing incorporation of basic information on oral health in the form of a health curriculum is the way forward for oral health promotion in Indian children, where a majority of their parents consider dental treatment unaffordable or inaccessible.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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