

Effect of a school-based oral health education programme in Wuhan City, Peoples Republic of China

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Objectives: To assess oral health outcomes of a school-based oral health education (OHE) programme on children, mothers and schoolteachers in China, and to evaluate the methods applied and materials used.

Design: The WHO Health Promoting Schools Project applied to primary schoolchildren in 3 experimental and 3 control schools in Hongshan District, Wuhan City, Central China, with a 3-year follow-up. Data on dental caries, gingival bleeding and behaviour were collected. **Participants:** 803 children and their mothers, and 369 teachers were included at baseline in 1998. After three years, 666 children and their mothers (response rate 83%), and 347 teachers (response rate 94%) remained. **Results:** DMFT/DMFS increments were comparable but the f/F components were higher among children in experimental schools than in control schools and the gingival bleeding score was, similarly, significantly lower. More children in experimental schools adopted regular oral health behaviour such as toothbrushing, recent dental visits, use of fluoride toothpaste, with less frequent consumption of cakes/biscuits compared to controls. In experimental schools, mothers showed significant beneficial oral health developments, while teachers showed higher oral health knowledge and more positive attitudes, also being satisfied with training workshops, methods applied, materials used and involvement with children in OHE.

Conclusions: The programme had positive effects on gingival bleeding score and oral health behaviour of children, and on oral health knowledge and attitudes of mothers and teachers. No positive effect on dental caries incidence rate was demonstrated by the OHE programme.

Key words: Oral health education, caries, gingival bleeding, oral health behaviour, China

At the global level, prevalence rates and patterns of oral disease have changed considerably over the past two decades. In most industrialised countries, the prevalence proportion rates of dental caries and the mean dental caries experience in children have declined^{1–4}. Such changes are often ascribed to changing living conditions and lifestyles, effective use of oral health services, implementation of school-based oral health care programmes, adoption of regular self-care practices and use of fluoride toothpaste^{5–7}. Against this, increasing levels of dental caries among children are observed in some developing countries, especially for those countries where community-based preventive oral care programmes are not established¹. In order to control the growing burden of oral diseases, a number of developing countries recently introduced school-based oral health education (OHE) and preventive programmes which aim at improving oral health behaviour and status of the child population. The initial evaluations from such health projects conducted in Indonesia⁸, Brazil⁹ and Madagascar¹⁰ have disclosed some encouraging results.

In China, the prevalence of dental caries of children at age 5 years was recently reported at 76.6% and



Figure 1. Map of study area: Hubei Province

the mean DMFT of 12-year-olds was 1.0¹¹. It is noteworthy that the d/D-component constitutes most of the caries index. Moreover, gingival health status and oral health habits of children seem poor¹¹⁻¹³. The Chinese health authorities have emphasised preventive oral care and oral health education since the late 1980s. The nationwide mass campaign 'Love Teeth Day' has been conducted annually since 1989 to support the implementation of community-based oral health education, with positive changes found at the population level^{14,15}. Oral health education in relation to schoolchildren is given high priority. In a previous survey, the Chinese schoolteachers showed higher dental knowledge and more positive attitudes towards prevention as compared with the parents¹³. Also, they expressed interest in becoming involved in oral health education of children. However, systematic school-based OHE programmes have not yet been established at the national level in China. In 1998, the

Hubei Province Committee for Oral Health, with the assistance of the World Health Organisation (WHO) Collaborating Centre for Community Oral Health Programmes and Research, University of Copenhagen, implemented demonstration projects in primary schools in Wuhan City, PR China. The purpose of the present study is to assess the outcome of the OHE programme on children, mothers and schoolteachers over a period of three years. The outcome is measured in terms of effect on dental caries experience and oral health habits of children, and oral health knowledge, attitudes and behaviour of mothers. In addition, levels of oral health knowledge and attitudes of teachers and their involvement in oral health education were measured for process evaluation.

Study population and methods

Setting

This evaluation study is based on a demonstration project carried out

in the Hongshan District of Wuhan City, Hubei Province, which is located in central China (*Figure 1*). The fluoride concentration of drinking water in the district is low (0.2ppm). Dental care is mainly offered on demand from one dental hospital with about 100 dental units and no organised school-based OHE programmes were established in the district. In 1998, six representative primary schools were chosen at random from this district; three were termed 'experimental' schools and three 'control' schools.

The OHE programme

All children in grade 1 attending experimental schools took part in a 3-year school-based OHE programme, based on the concept of the WHO Health Promoting Schools Project aimed at healthy environment and involvement of schoolteachers in classroom activities. These activities focussed on integrating oral health education

into the general curriculum of training and education for health. Active involvement principles and various didactic materials were chosen for the children and in order to enable teachers to conduct OHE, a 2-day training workshop was organised for them by district education officers and senior dentists with a background in dental public health. The head teacher and another ten teachers of each experimental school attended the workshop, which took place prior to the programme (August 1998). Training was in the value of teeth and general health, diet and nutrition, oral anatomy and tooth development, causes and prevention of dental caries and periodontal disease, self-care and effective use of fluorides, and emergency oral care at school. Particular emphasis was given to oral hygiene procedures, protection of the first permanent molars and the benefits of fluoride. One-day, follow-up workshops were arranged for reinforcement in August 1999 and 2000 and included discussions and exchange of programme experience among teachers.

All teachers were instructed in the use of a health education manual¹⁶ encompassing an appropriate booklet and a guide for including oral health into lessons, use of health education materials such as a manuscript for puppet theatre, accompanying text for slide shows, macromodels, flannel graphs and worksheets as well as a simplified questionnaire for self-evaluation of oral health knowledge by children. The classroom instructions focussed on general health, oral health, teeth and their functions, dental plaque and tooth decay, diet, sugar and health (general and dental), self-care for oral health and the importance of dental visits. The children took part in daily oral hygiene instructions supervised by the teacher and were instructed in a vertical short-stroke brushing method. Tooth brushing twice a

day with use of fluoride toothpaste was recommended. Moreover, the mothers were encouraged to be present during oral hygiene instructions and were informed about methods of cleaning and how to take responsibility for their child's teeth on a daily basis. In addition, the schools received various macromodels, slides, posters and other didactic materials to support the OHE activities. Monthly OHE sessions were part of the curriculum and instructions were performed on average 30 times over the 3-year evaluation period. Throughout the project activities in schools were supervised by public health dentists.

Participants

In 1998, a total of 918 children were clinically examined and 803 mothers (87% of the original sample) completed self-administered questionnaires. Only children who were examined and whose mothers completed the questionnaires were included in the baseline data, with 404 children (86% of the original sample) in the experimental and 399 (89% of the original sample) in the control group. In addition, 33 teachers responsible for children in the experimental schools were included and 336 teachers from other schools of the district served as the reference group. In all, 88% of teachers chosen responded to the questionnaires.

At the follow-up examination in 2001, 335 children and 331 children remained in the experimental and control groups, respectively. The drop-out rate was 17%; most being caused by transfer of children to other schools or their mothers being absent when the questionnaires were to be completed. At follow-up, there were 32 teachers (drop-out rate 3%) and 315 teachers (drop-out rate 6%) who remained in the experimental and control schools, respectively.

Collection of data

The baseline oral examination was carried out in September 1998 and the follow-up examination took place in October 2001. Children from the six primary schools participated in a clinical examination of dental caries and gingival conditions. The recordings were based on the criteria of the Recording System for the Danish Municipal Child Dental Health Services¹⁷. The clinical examinations were performed in classrooms under natural daylight using standard explorers, mirrors and the Community Periodontal Index probes¹⁸. Prior to the study, the examiners were calibrated against a master examiner. The kappa statistic was used to assess the inter-examiner reliability of caries and the final kappa scores were higher than 0.85¹⁸. Data on oral health behaviour of the children and their mothers, and information about oral health knowledge and attitudes of mothers were collected by self-administered standardised questionnaires. Completion of questionnaires took place in classrooms supervised by teachers or dentists. The structured questionnaires have been described earlier and the validity and the reliability of the questions have been tested in previous Chinese studies^{12,13}.

In addition, the teachers of the six primary schools responded to structured questionnaires for assessment of oral health knowledge and attitudes. In order to evaluate the education methods applied and materials used in the OHE programme, a semi-structured questionnaire was given to those teachers who were involved in the OHE programme during the 3-year study. The questionnaires were developed and pre-tested in China by the WHO Collaborating Centre for Community Oral Health Programmes and Research, University of Copenhagen and the School of Stomatology, Wuhan University.

Data analysis

All data sheets were transferred to the University of Copenhagen and analysed by means of the SPSS system. Dental caries experience was measured by caries indices (dmft/dmfs, DMFT/DMFS), and mean scores at baseline and caries increments (DMFT/DMFS) were calculated. The gingival conditions were assessed by recording presence/absence of bleeding on twelve indicator teeth¹⁷ and the mean percentage of teeth scored with gingival bleeding was then calculated (bleeding scores). Frequency distributions were used for analysis of data on oral health knowledge and habits. In order to describe changes over time in oral health knowledge and attitudes among the mothers and teachers, a number of additive indices were constructed: knowledge about causes and prevention of caries and gingivitis (scores 0–16); attitudes towards dental care of mothers (scores 0–7); and attitudes towards dental care of teachers (scores 0–10). The scales were designed to fit the Guttman-scale model¹⁹ and in the final analysis the various scales were categorised empirically into high, moderate or low levels. Differences in changes over-time between the two groups were compared using the independent-samples t-test for mean scores as regards the clinical variables while the Chi-square test was applied for categorical variables.

Results

Oral health status and behaviour of children

At baseline no significant differences in dental caries experience were observed between the experimental and control groups, and *Table 1* presents the changes over time in dental caries occurrence for primary and permanent teeth, and the bleeding scores of the two groups. The mean increments in f-s were 0.33 and 0.06 of the

Table 1 Mean dental caries experience (dmfs/DMFS) and mean bleeding scores (Percentage of scored teeth with gingival bleeding) in Chinese children at baseline and at follow-up

	Control (n=331)		Experimental (n=335)	
	Baseline	Follow-up	Baseline	Follow-up
PP% (primary)	71.4	65.5	69.6	66.6
d-s	7.6	4.4	7.5	3.8
m-s	0.1	0.3	0.2	0.3
f-s	0.4	0.4	0.5	0.8
dmf-s	8.1	5.1	8.1	4.9
PP% (permanent)	4.4	18.4	4.2	21.8
D-S	0.1	0.3	0.1	0.1
F-S	–	–	–	0.2
DMF-S	0.1	0.3	0.1	0.3
Bleeding scores (%)	12.4	32.2	11.5	25.0

experimental and control groups, respectively ($p < 0.01$); in parallel, the mean increment of F-S was higher in the experimental group than in the control group (0.16 against 0.03; $p < 0.01$). The over-time difference of bleeding scores was lower for experimental children than that for control children (14% against 20%; $p < 0.05$). There were no significant differences in DMFS and DMFT increments between the two groups.

Table 2 illustrates the oral health habits and consumption of various sugary drinks/foods among the children. The over-time changes in oral health habits were significantly different for the two groups. The increase in proportion of children with tooth brushing at least twice a day was about 26% for the experimental group and 19% for the control group ($p < 0.05$); dental visits within the previous year grew higher among experimental children than in control children (10% against 3%; $p < 0.01$). Moreover, increments in use of fluoride toothpaste were 11% and 5% in the experimental and control groups, respectively ($p < 0.01$). With respect to consumption of various sugary drinks/foods, significant difference was found only for the frequency of eating cakes/biscuits, which was a 5% increment in the control group and a 5% decline in the experimental group ($p < 0.01$).

Knowledge, attitudes and habits of mothers

Table 3 summarises the over-time changes in oral health knowledge, attitudes and habits of mothers, where significant difference in attitudes towards dental care was found between groups ($p < 0.01$). The proportion of mothers who cleaned their child's teeth weekly was significantly higher for the experimental group as compared to the control group ($p < 0.01$). In addition, the proportion of mothers who checked the teeth of their child after brushing grew at the level of 14% and 5% for the experimental and control groups, respectively ($p < 0.01$).

Knowledge and attitudes of teachers

Significant developments in oral health knowledge and attitudes towards dental care were observed for teachers at the follow-up (*Table 4*). High scores of knowledge and positive attitude scores changed at 40% and 28% among teachers of experimental schools while corresponding figures were only 5% and 8% in teachers of the control group, respectively ($p < 0.01$). The proportion of teachers who gave oral health instruction to children during the previous year increased at 34% in the experimental group and 7% in the control group

Table 2 Percentages of Chinese children with certain oral health habits at baseline and at follow-up

	Control (n=331)		Experimental (n=335)	
	Baseline	Follow-up	Baseline	Follow-up
Toothbrushing at least twice a day	31.3	49.8	35.2	60.9
Dental visits within the last year	34.4	36.9	37.9	47.8
Using fluoride toothpaste	73.1	78.2	74.9	86.3
Milk with sugar at least once a day	29.0	32.3	31.9	30.1
Sugary drinks at least once a day	6.3	5.4	7.8	5.7
Cakes/biscuits at least once a day	15.4	20.5	17.6	12.5
Sweets/chocolate at least once a day	4.2	5.7	5.1	5.7

Table 3 Percentages of Chinese mothers with oral health knowledge, attitudes and habits at baseline and at follow-up

	Control (n=331)		Experimental (n=335)	
	Baseline	Follow-up	Baseline	Follow-up
High knowledge scores (9–16)	43.5	36.0	38.8	39.1
High attitude scores (6–7)	48.6	40.5	43.3	51.3
Toothbrushing at least twice a day	60.4	69.5	61.5	73.7
Dental visits within the last year	17.6	26.9	15.4	20.9
Help to clean child's teeth weekly	4.8	4.5	6.9	11.9
Check child's teeth after cleaning weekly	11.8	16.6	13.4	27.5
Talk about cleaning to child weekly	20.2	23.9	22.1	19.7

Table 4 Percentages of Chinese teachers with oral health knowledge, attitudes and practices at baseline and at follow-up

	Control (n=315)		Experimental (n=32)	
	Baseline	Follow-up	Baseline	Follow-up
High knowledge scores (9-16)	59.0	64.1	53.1	93.8
High attitude scores (9-10)	61.3	69.5	68.8	96.9
Children's teeth are good	14.3	8.9	12.5	25.0
Children's teeth need treatment	71.7	65.4	75.0	53.1
Gave instruction to children last year	71.4	77.8	62.5	96.9
Hours allocated for OHE (mean)	2.1	1.9	1.7	3.8

Table 5 Chinese teachers distributed (%) according to their opinion on the use of educational methods (n=32)

	Good	Fair	Bad
Traditional lessons	–	28.1	71.9
Puppet theatre	75.0	25.0	–
Playing	71.9	28.1	–
Group meetings	56.3	43.7	–
Exhibition of materials	71.9	28.1	–
Use of slides	56.3	43.7	–
Use of macromodels	68.8	31.2	–
Use of flannelograph	56.3	43.7	–
Drawing by children	75.0	25.0	–
Meeting with parents	78.1	21.9	–

($p < 0.01$). The time allocated for OHE was higher for the experimental group but declined slightly in the control group ($p < 0.01$). All teachers in the experimental schools held the opinion that schoolteachers should inform children about oral health whereas 90% of the

teachers in the control schools held this opinion ($p < 0.05$).

Evaluation by teachers

Nearly all teachers in experimental schools were very satisfied or satisfied with the content of the

training workshops and 75% of teachers felt that they subsequently had sufficient knowledge to teach children about teeth and their care. As regards the means for health education, about three quarters of the teachers considered meetings with parents important and high

Table 6 Chinese teachers distributed (%) according to their opinion on materials used for education (n=32)

	Good	Fair
Manual for teachers	37.5	62.5
Worksheets for children	87.5	12.5
Slides	56.3	43.7
Macromodels	59.4	40.6
Flannelograph	56.3	43.7

proportions of teachers reported that drawings by children, puppet theatre, playing and production of materials for display were effective (Table 5). As to the educational materials, the majority of the teachers stressed that worksheets for children were good; about one third of the teachers indicated that the manual for teachers was good whereas two thirds answered that this material was fairly good (Table 6). Finally, all teachers felt very satisfied or satisfied by being involved in oral health education for children.

Discussion

In the People's Republic of China, the public oral health service is generally orientated towards curative care and the population is served by public hospitals, health care centres or clinics of schools or factories²⁰. Since the late 1980s, initiatives have been taken to implement preventive oral care programmes and oral health education and the National Committee for Oral Health has emphasised that oral health promotion to children should be given priority. In order to gain experience from organisation of school-based oral health promotion programmes, a few pilot studies were carried out in China. For example, a recent study reported the experiences of a six-year school-based oral health promotion programme in Wuhan City²¹. In this programme, dentists went to primary schools and performed OHE instruction to children and their parents annually, and preventive and curative care

was provided to the children at low charges. Although some effects were shown, the programme may not be easy to extend nationally due to the scarce dental manpower resources in China. In the present study, however, the OHE programme was based on the concept of the WHO Health Promoting Schools Project, which aims at involvement of schoolteachers in classroom health activities¹⁶. The resources needed for health education and training of trainers were relatively lower and the OHE programme may therefore have national relevance.

Representative primary schools were covered by the current evaluation, the study was carried out as a community trial and based on a three-year follow-up design. The drop-out rate of the participants after three years is low and no significant differences were found between the study groups as regards sex, oral health status, oral health behaviour of children and educational level of mothers. Thus, the drop-out level is considered not to have a serious effect on the outcome evaluation. Some examiner bias in this study cannot be excluded, since the dentists may have been aware of which schools served as experimental and which comparison. Systematic calibration trials were conducted in order to ensure reliability of recording of dental caries and the consistency level was high as measured by WHO standards¹⁸.

The registration of dental caries was based on the criteria of the Recording System for the Danish Municipal Child Dental Health Services¹⁷. This epidemiological

system was established in order to plan and evaluate the services delivered. The clinical examination procedures and the diagnostic criteria are very close to the WHO methods¹⁸ and therefore comparisons with other studies are possible. The present findings at baseline are in agreement with previous Chinese surveys of 6-year-olds, which have shown the mean dmft at 3.9–5.7 and DMFT at 0.1–0.4^{13,22}. No reduction in caries increment was found for children of the participating schools and this confirms observations from other studies on the clinical effects of OHE^{23,24}. It is worth noting that it may also be somewhat difficult to demonstrate reductions of caries incidence rates in population groups with low caries level. The significant increment of the f/F components of the caries indices as observed for children of the experimental group reflects the changing dental visiting habits of children.

Gingival bleeding is commonly used to evaluate the status of oral hygiene of children. The mean bleeding scores of the actual child population are in accordance with other studies of children in China²⁵ and Tanzania²⁴, and the present data confirm the previous reports of poor oral hygiene status among Chinese children^{12,21}. In this study the bleeding scores were significantly lower for children of experimental schools than those of controls. This is in agreement with the results of a similar school-based OHE programme in Tanzania, where significant reduction in gingival bleeding was documented after 3 years²⁴. Meanwhile, intervention studies of school-based OHE programmes have reported equivocal conclusions regarding the oral hygiene outcome effects²³. This may be ascribed to the different principles of education applied for promotion of oral hygiene among school children, which varied from simple once-only instruction to extensive and repeated oral hygiene instructions. The present OHE

programme was characterised by active participation, empowerment and reinforcement, and such approaches are considered most important in behaviour modification. Other OHE programmes including these elements have been shown to be successful in improving oral hygiene among children^{8,26}.

The data on oral health behaviour were collected by means of self-administered questionnaires and due to the school-based approach highly acceptable response rates were obtained for both data sets of mothers and schoolteachers. However, the data collection method may have certain limits²⁷. With respect to oral health knowledge, attitudes towards dental care, oral hygiene habits, frequency of dental visits and time allocated for OHE, some over-reporting may be assumed whereas underreporting has to be considered with regard to the consumption of sweets, sugary foods and drinks.

The present study indicates a positive effect of the OHE programme since more children in experimental schools adopted regular oral health behaviour such as tooth brushing at least twice a day, dental visits annually, use of fluoride toothpaste and less frequent consumption of cakes/biscuits as compared to children from control schools. The effect was moderate and in accordance with other studies which have reported positive effects of OHE on oral health behaviour^{8,9,28}. Some improvement in oral health behaviour was also found for children in control schools and this may be ascribed to the fact that children matured during the period of study or it may reflect an effect of other health education activities such as the LTD-campaign. The proportion of children with tooth brushing at least twice a day was about 60% in the experimental group; this proportion is higher than recorded in the Middle East^{29,30}, but significantly lower than figures found in Thailand³¹ and in some European

countries^{32,33}. It is remarkable that in the present study the frequency of tooth brushing among children was at the same level as for their mothers. Consistent to previous reports^{12,13}, the study indicates that consumption of sweets and sugary drinks among Chinese children seems to be relatively low when compared to European data³³. It is noteworthy that one third of children had milk with sugar at least once a day, which is higher than found in a previous report¹³. This may be due to several factors; first, milk had been recently recommended by the Chinese health authorities as a public health measure, especially for the child population; secondly, there is an upward trend in consumption of milk due to higher accessibility; and thirdly, many parents may not be really aware of the harmful effect on teeth of hidden sugar. Thus, the future school-based OHE programmes are supposed to give particular emphasis on the negative effect of hidden sugar as well as frequency of tooth brushing. The relevance of using fluoride toothpaste should also be given further attention in order to ensure adequate exposure to fluoride.

The support by the family is crucial in the development of children's habits in relation to health. Cooperation with the parents was therefore considered an important component of the present OHE programme; the mothers were invited to schools at least once a year during the 3-year period in order to encourage them feel high responsibility with regard to their child's teeth. Relatively more mothers from the experimental schools showed positive attitudes towards dental care; they more often cleaned their child's teeth weekly or teeth were checked after their children had brushed. This result may indicate that the OHE programme had a positive effect on the mothers' attitudes and behaviour and which is relevant to the improvement of behaviour and

oral health status among the children.

A successful school health programme would also depend on the responses by teachers³⁴. Some previous OHE programmes were not reported successful since the teachers received limited instruction on dental health education or they lacked motivation^{34,35}. The present OHE programme had arranged training workshops annually for the teachers in order to ensure reinforcement and follow-up, to provide for exchange of knowledge and experience and to keep motivation high. The teachers involved in the programme activities gained higher oral health knowledge and more positive attitudes towards dental care when compared with the teachers in control schools. Moreover, the active participation of the teachers contributed to the implementation of the OHE programme.

In order to serve as a demonstration project in China, the teachers were asked to evaluate the organisation of work, methods applied and materials used in the OHE programme. In general, the teachers were very satisfied or satisfied with the training workshops and most of them felt that they gained sufficient oral health knowledge for teaching children. They all indicated that the educational principles applied in the programme were better than traditional lessons. As to the educational materials, the worksheets developed for children were highly appreciated whereas the health education manual for teachers had somewhat lower scores. The feedback given by teachers is most valuable for the modification of the health education manual for it to match the Chinese education system and culture when OHE programme will be carried out in other locations in China.

In recent years, some literature reviews addressed the question 'Is dental health education effective?' and the conclusions are still unequivocal^{23,34,36}. The health educa-

tion principles used in interventions varied considerably, from the simple provision of information to the use of advanced strategies based on psychosocial models for behaviour change. The goals of intervention programmes also varied in that knowledge, attitudes, intentions, beliefs, self-care, use of dental services and oral health status, have all been targeted for change^{23,34}. Positive effects of programmes may be obtained as regards health-related knowledge and/or behaviour even when health outcomes are not observed⁹. In the present OHE programme, positive effects were found on oral health behaviour and gingival status of the children, on oral health attitudes and behaviour of the mothers, and on oral health knowledge and attitudes of the teachers. No effect as regards prevention of dental caries was observed. Meanwhile, involvement of teachers in this school-based OHE programme proved to be feasible and effective, and it is recommended to establish such programmes in other areas of China.

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