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Comparison of the effects of secondary prevention in schoolchildren between hospitals with and without mobile dental services in Southern Thailand

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Abstract: The aim of the present study was to compare the performance of hospital clinics with and without adjunct mobile services for the delivery of secondary prevention for caries in Thai schoolchildren. A dental survey was conducted in schools served by different dental services. 711 schoolchildren were selected from primary schools in Southern Thailand by multistage cluster random sampling. WHO basic oral health survey methods were employed to evaluate three outcomes of secondary prevention: 1) Coverage of secondary prevention – all filled teeth (FT+D_FT) among caries experienced teeth (DMFT), 2) Effectiveness of secondary prevention – successfully filled teeth (FT) among all filled teeth (FT+D_FT) and 3) Protective effect of secondary prevention- successfully filled teeth (FT) among caries experienced teeth (DMFT). The respective percentages were 74.3, 97.5 and 72.5 in the children served by hospital-only services, and 41.3, 97.2 and 40.2 in the other group. From clustered logistic regression modeling, only the first and third outcomes were significantly different between the two access groups. This study showed that adjunct mobile service may be less effective in secondary prevention. (J Oral Sci 51, 97-102, 2009)

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Introduction

Secondary prevention involves early detection and prompt intervention to control disease and minimize disability and is needed for individuals in whom primary prevention has failed (1). Mobile dental clinics have been arranged in both developed and developing countries in order to increase accessibility to dental services, especially among children (2,3). In most developed countries, the mobile clinics are generally made available to specific target groups such as low-income or deprived children. In developing countries, mobile dental programs are more broadly focused on school populations. However, studies to evaluate the effectiveness of mobile dental services on the oral health status of children are rare.

Although the World Health Organization (WHO) has developed standardized methods for the measurement of dental health status and needs for care (4), little attention has been given to the use of these measures to evaluate the effectiveness of secondary prevention. Application of the dmf/DMF index for the evaluation of secondary prevention has certain limitations. In particular, it cannot detect changes in the ‘quality’ of teeth already attacked by caries, since it does not distinguish among decayed, filled or missing teeth (5). In this study, we used the measures described in the WHO manual as a basis for measuring the outcome of secondary preventive measures in Thailand.

Thailand has a high caries prevalence with low coverage of the population by dental services. Data from successive National Oral Health Surveys show that the percentage of 12-year-old children with dental caries experience in permanent teeth increased steadily from 45.8 to 57.3 between 1987 and 2002 (6). Over decades, school oral health services have been expanded from school visits solely for the extraction of extensively carious teeth to also include promotion of tooth brushing, fluoride mouthwash, surveillance of dental caries by trained school teachers, filling and sealant services. These services are managed and delivered by the Dental Health Department of the Community hospital.

Under the Thai Universal Health Insurance Scheme, all children are entitled to free dental services provided at the hospital dental health unit or any mobile clinics of the hospital. The use of mobile clinics varied between hospitals. This study uses components of the DMFT to identify and measure the effectiveness of secondary prevention, and hence evaluate the use of adjunct mobile clinics for dental care delivery. The objective was to compare the effectiveness of secondary prevention of caries in Thai schoolchildren under two different delivery models; hospital dental units with and without mobile services.

Materials and Methods

The evaluation was based on a school dental survey involving five districts in Songkhla province, Southern Thailand. The study population included primary schoolchildren from both rural and suburban communities, where the parents were mainly low to middle income farmers.

Multistage cluster sampling with probability proportional to size (PPS) was used. The primary sampling unit was school. Among the total of 140 schools, 30 were randomly selected for the study. From each school, pupils were selected for the study by systematic random sampling. Sample size calculation was based on the formula $n = \frac{z^2\sigma^2}{d^2}$, where n = sample size, σ = standard deviation in the number of children with caries in each grade and d = half of the interval width of the estimate (7). To obtain an acceptable level of precision of the estimate, we set σ = 2.13 (obtained from a field survey by Faculty of Dentistry, Prince of Songkla University (8)), d = 0.4 and Z at 95% confidence = 1.96. This produced a required sample size of 109 per grade. There were 6 grades in each primary school implying a total sample size of $109 \times 6 = 654$. Grade was a stratification factor for practical reasons, but it also provided a rough surrogate of the children's age group. This sample size requirement was increased by 10% to compensate for non-respondents; leaving a final sample size of 727 to test the hypothesis of difference in effects between the two patient groups with the outcome being a continuous variable related to the number of affected teeth.

Parents of fifteen children refused to participate (response rate = 97.9%) and one child was excluded from the analysis because he did not have any permanent teeth. Thus, 711 children were left to form the study sample. Data on dental status were collected by a single examiner (ST) between February and June 2005 using the criteria of the WHO Oral Health Survey methods (4). The examination was performed under field conditions using a standard oral health examination set: patient chair, operator stool, assistant stool, artificial light, hand-instruments: mouth mirror, periodontal probe, cotton pliers, cotton roll and gauze. Prior to the examination, the examiner standardized her precision of oral health examination by examining 30 pupils: each pupil was examined twice with a one-day interval. The unweighted Kappa of these examinations was 0.95 for dental status and 0.80 for treatment need, which represent acceptable levels of reproducibility.

Data on age, gender, religion and parents' occupation were retrieved from the schools records as baseline characteristics of the children. The occupation of parents in this study would reflect the socioeconomic status (SES) and was divided into 3 groups; laborers, agriculture workers and businessmen and government officers. Laborers represented the lowest SES and included parents employed at any working place who did not have their own gardens, rice fields or prawn farms. Agriculture workers included any parent who had their own land and worked as a farmer on their land. Businessmen and government officers represented the highest socioeconomic status.

Baseline characteristics included data on whether the hospital used a mobile clinic or not, the number of responsible personnel per 1,000 children and frequency of tooth brushing among the total children in the district.

The research protocol was approved by the Ethical Committee, Faculty of Medicine, Prince of Songkla University. Parents were sent information leaflets explaining the purpose of the study and consent forms one to two weeks before the commencement of data collection. After examination, the researcher reported the results to parents and referred children with carious teeth to a dentist at the children's registered hospitals.

Children were enrolled in the program at the age of 6-8 years. In this area, most of the primary dentition is already affected by caries at this age. Dental health status indicators used in this study therefore focused on the permanent dentition, which was the highest priority under the program. Dental health status indicators used in this study were FT (previously filled teeth without decay) and

Table 1 Summary of dental indicators and evaluation type

Prevention level and dental indicators	Teeth at risk
Coverage	
Success: FT+ D_FT (Filled without decay teeth + Filled with decay teeth)	Total teeth experienced caries
Failure: $D_{NF}MT$ (Non-filled with decay and missing teeth)	
Effectiveness	
Success: FT (Filled without decay teeth)	Total filled teeth
Failure: D_FT (Filled with decay teeth)	
Protected teeth	
Success: FT (Filled without decay teeth)	Total teeth experienced caries
Failure: D_FT (Filled with decay teeth) + $D_{NF}MT$ (Non-filled with decay and missing teeth)	

Table 2 Provider institute characteristics of five selected districts

Characteristics	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Hospital 5
Number of personnel (dentist and dental nurse) per 1,000 of children	3.0	1.6	0.8	0.7	1.0
Dental service approach	Hospital services	Hospital and mobile	Hospital and mobile	Hospital services	Hospital and mobile
Tooth brushing coverage (%)	98.7	99.7	100.0	99.7	99.8

DT (decayed teeth). DT was divided into two components; D_FT (previously filled teeth with decay) and $D_{NF}MT$ (non-filled teeth with decay and missing teeth) (Table 1).

Teeth eligible for secondary prevention are those with caries. The sole method of secondary prevention in the community is filling. The outcome of secondary prevention was therefore successful filling (FT) or unsuccessful filling (D_FT). Dividing all previously filled teeth (FT+D_FT) by DMFT provided a measure of coverage of secondary prevention or the proportion of all unhealthy teeth that had been filled (row 2, Table1). The effectiveness of secondary prevention was measured by the proportion of healthy filled teeth among all previously filled teeth i.e., FT/(FT+D_FT) (row 3, Table1) while the proportion of teeth protected by secondary prevention was measured by FT/DMFT (row 4, Table1). In this study, we could not identify whether MT was failure of secondary prevention or the result of not receiving secondary prevention (i.e., coverage). However, information from hospital accreditation reports (9) showed that the number of failed fillings per year was less than 1 and most of these were found in adult patients. We, therefore, assumed that MT was the result of non-coverage by secondary prevention. Therefore, children in whom primary prevention failed and who were not covered by secondary prevention were included in the category of non-filled teeth with decay and missing teeth ($D_{NF}MT$).

All data were entered using Epidata version 3.1b (10) and R program version 2.4.1 (11). For each tooth, an individual had one of two possible outcome variables, success or failure, for each of the three performance measures (Table 1). These outcomes were tested against the same set of independent variables; age, gender, religion, occupation of the parents, provider per population and whether the hospital utilized a mobile clinic.

For each hypothesis, logistic regression was used to estimate the probability of success in terms of each child as predicted by the independent variables. Since the teeth were clustered within the same individual, the effective sample size was adjusted by the method described by Rao and Scot (12). In brief, standardized residuals from logistic regression were computed for each record and the variance inflation factor (or design effect) was calculated. This factor was used to adjust the sample size by dividing the number of teeth with success and failure in the data set with the calculated variance inflation factor and the result was used as outcomes for final modeling.

Results

The supply data are presented in Table 2. The personnel to target population ratio had a wide range with a 4-fold difference between hospitals. Hospitals 1 and 4 provided dental services only at the hospital, whereas Hospitals 2, 3 and 5 also delivered mobile dental services. All districts had very high coverage of the tooth brushing program.

Table 3 shows baseline characteristics of 711 school children by the type of hospital (with and without mobile dental services). There were significant differences in religion and occupation of the parents among the two groups of hospitals. In hospitals with mobile dental service, there were both Buddhist and Muslim children. Most parents belonged to the business and government officers' group. The average number of erupted permanent teeth per child was 17.8.

Table 3 Baseline characteristics of 711 school children

Characteristics	Hospital only	Hospital and mobile	Statistical test*
Gender: frequency (percentage)			
Boy	129	228	0.95
Girls	107	247	
Age (year): mean	10.15	10.08	0.62
Religion: frequency (percentage)			
Buddhist	236	415	< 0.001
Muslim	0	60	
Parents' occupation: frequency (percentage)			
Labors	127	176	< 0.001
Agriculturers	16	58	
Businessman and government officers	93	241	
Number of erupted permanent teeth: mean	17.72	17.80	0.88

* Chi-square test for gender, religion and parents' occupation, and *t*-test for age and number of erupted permanent teeth.

Table 4 Mean and standard deviation of related dental indicators in each level of prevention of 711 children by access

Indicators	Access	
	Hospital only (n = 236) Mean (SD)	Hospital and mobile (n = 475) Mean (SD)
DMFT	0.92 (1.27)	1.08 (1.53)
FT	0.67 (1.07)	0.43 (0.92)
D_FT	0.02 (0.13)	0.01 (0.11)
$D_{NF}MT$	0.24 (0.54)	0.63 (1.19)

Table 5 Percentage of children and teeth of 711 children by dental health status indicators and access

Indicators	Access			
	Hospital only (n = 236)		Hospital and mobile (n = 475)	
	% of children	% of teeth	% of children	% of teeth
Coverage [b]				
Success: FT + D_FT	N/A	74.31	N/A	41.33
Failure: $D_{NF}MT$	40.91	25.69	69.92	58.67
Effectiveness [c]				
Success: FT	N/A	97.53	N/A	97.17
Failure: D_FT	4.65	2.47	5.36	2.83
Protected teeth [b]				
Success: FT	N/A	72.48	N/A	40.16
Failure: D_FT + $D_{NF}MT$	42.73	27.52	69.92	59.84

Number of teeth at risk: a = total erupted permanent teeth, b = total experienced carious teeth, c = total filled teeth N/A = not applicable as the number are not meaningful.

Dental status indicators by patient groups are summarized in Table 4. The average DMFT per child increased from 0.44 in children aged 7 to 2.09 in children aged 13. The distribution of DMFT in both groups was similar. The patients at hospitals with adjunct mobile services had lower FT and D_FT but higher $D_{NF}MT$ indicating poorer coverage of secondary prevention.

Results from analysis based on the number of children and teeth at risk are summarized in Table 5. In general, the percentage of children and the percentage of sound teeth in the "hospital only" group were higher than in the "hospital and mobile" group, especially for coverage and protection (filled teeth). The results from the clustered logistic regression model (see Table 6) could not be used to determine the effectiveness of fillings due to the small numbers of D_FT (4 teeth from "hospital only" and 6 teeth from "hospital and mobile" group). The estimated coefficients of the final model were similar to those for the unadjusted logistic regression (data not shown), but the standard error was inflated because of the smaller effective sample size. The results are displayed as coefficients, standard errors and significance levels of the independent variables. The results of the model confirm better outcomes for the "hospital only" group. The hospital with mobile dental service had coverage and protected teeth 0.24 times compared with hospital only group.

Table 6 Coefficient from linear logistic regression with dental health status indicators as the dependent variables

Variables	Coverage Outcome (FT+ D_FT, $D_{NF}MT$)	Protected teeth Outcome (FT, DMT)
	β (SEM), *P*-value	β (SEM), *P*-value
Intercept	0.762 (0.656)	0.920 (0.659)
Age	0.039 (0.055)	0.014 (0.055)
Gender		
Boy		
Girl	0.304 (0.196)	0.420 (0.198)*
Religion		
Buddhist		
Muslim	-0.349 (0.313)	-0.288 (0.316)
Parent's occupation		
Labor		
Agriculturers	-0.073 (0.313)	-0.033 (0.316)
Businessman and government officer	-0.178 (0.214)	-0.165 (0.215)
Manpower	-1.212 (1.723)	-1.442 (1.717)
Access		
Hospital only		
Hospital and mobile	-1.437 (0.237)***	-1.431 (0.237)***
Design effect	1.483	1.502

Significant level: $*P < 0.05$, $** P < 0.01$, $***P < 0.001$

Discussion

After adjustment for different workloads between the two groups of clinics (with and without mobile units), the hospital-only group had better coverage of secondary prevention or filling services and could protect more teeth from caries progression.

The WHO global goal for the year 2000 was that DMFT be less than 3 at 12 years of age and the corresponding Thai goal be 1.5 (6) This goal was achieved in the present study population. The DMFT score of 1.53 observed in this study is lower than the national average DMFT of 1.64 in this age group. The major component of DMFT at the national level was decayed teeth (D = 1.14, M = 0.07, F = 0.43), while in this study, filled teeth were the most prominent component of the index score (D = 0.65, M = 0.04, F = 0.84, data available from the authors) indicating that the study population had better coverage of filling services in addition to less caries experience. As far as we are aware of, this is the only report that shows the oral health status of children in Southern Thailand is better than that for the country as a whole and the findings are in contrast with previous reports (6).

Both coverage and protected teeth were greater in the hospital-only population. These results might be explained by parent preferences for hospital-based clinics (13), leading to greater willingness to use services in hospital based clinics. In addition, hospital-based clinics may require less time for preparation, allowing them to focus resources on the direct delivery of services and hence, higher levels of coverage. Moreover, should hospital clinics be able to provide higher quality services this would mean greater effectiveness of care as the rate of filling failure would be less than in mobile clinic services. However, the observed rates were too low to demonstrate any significant difference between the two groups. With good geographic distribution of hospitals, relatively few problems may be encountered for transportation from home to hospital and parents seemed to have a better perception of better care at the hospital than at the mobile dental clinic in the study. Therefore, the results of this study can not be extrapolated to communities in different settings. There might be other factors related to the individual or hospital which affected the results of the study such as characteristics of the population. Similar studies should be repeated in other regions before a final conclusion can be drawn.

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