# THE EVALUATION OF A MULTI-LEVEL ORAL HEALTH INTERVENTION TO IMPROVE ORAL HEALTH PRACTICES AMONG CAREGIVERS OF PRESCHOOL CHILDREN

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**Abstract.** This study reports the effects of a pilot multi-level oral health intervention on caregivers' oral health practices and their determinants. Quasi-experimental, pretest-posttest evaluations using a comparison group design were employed to evaluate the effectiveness of a proposed intervention for promoting caregiver oral health behavior. The intervention consisted of three components: home visits by lay health workers (LHWs), enhancing oral health education and services at health centers, and community mobilization. These components were designed to target factors at intrapersonal, interpersonal, organizational and community levels based on a Social Ecological Model (SEM). Four oral health behaviors associated with early childhood caries (infant bottle feeding, tooth brushing, snack consumption and fluoride use), and multi-level determinants were assessed during pre- and post-tests. The one-year intervention demonstrated a positive effect on tooth brushing, using toothpaste, and fluoride supplements, but did not have a significant effect on bottle feeding and snack consumption among children. The intervention also had no effect on dental caries; in fact caries increased in both control and experimental groups. The caregiver knowledge, attitudes, outcome expectations, and self-efficacy towards these behaviors were significantly increased in the experimental group after intervention. Caregivers in the experimental group received greater social support by LHWs and health center staff than those in the control group ($p<0.001$). The program had an impact on integrating oral health services at health centers and community participation in children's oral health. These findings confirm multi-level factors influence reported oral health behavior, but not outcomes in terms of caries. Process evaluation is needed to determine actual implementation levels, barriers and suggests for modification of the program in the future to improve outcomes in terms of caries.

**Keywords**: social ecological model, oral health promotion, early childhood caries, caregivers, preschool children

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## INTRODUCTION

Although dental caries is a preventable disease, it is the most prevalent infectious diseases in children (Evans and Kleinman, 2000). Many children in developed and developing countries are affected by dental caries and suffer from unnecessary dental pain and infections (De Grauwe *et al*, 2004). In Thailand, 80.6% of 5-6 year olds and 61.4% of 3 year olds are affected by dental caries (Department of Health, 2007). Caries begin very early and progress rapidly among children in rural areas. In 15-19 month old children, the prevalence of dental caries was 82.8% in one study and including both cavitated and non-cavitated lesions (Vachirarojpisan *et al*, 2004). The children with early childhood caries (ECC) demonstrated a higher risk for future caries (Peretz *et al*, 2003), increased numbers of hospitalizations and emergency room visits (Wadhawan *et al*, 2003), increased treatment costs and time, loss of school days, and diminish ability to learn (Filstrup *et al*, 2003). ECC is a neglected health problem that has a significant impact among infants and young children.

While recognizing the complex relationship between ECC and socio-behavioral factors, few oral health promotion programs have been designed to address the social and environmental factors that influence oral health behavior. Oral health promotion includes efforts to change organizational behavior, as well as the physical and social environments. The social ecological model (SEM) is a versatile model that allows a researcher to think through health determinants at various levels. Two key ideas from an ecological perspective help identify personal and environmental leverage points for health promotion and education interventions (Sallis and Owen, 2002). The first key idea is that behavior is affected by, and affects, multiple levels of influence. These levels have been described by McLeroy *et al* (1988) as intrapersonal or individual level, interpersonal level, organizational level, community level and policy level. The second idea, called reciprocal causation, suggests that individual behavior both shapes and is shaped by social environment (Sallis and Owen, 2002). The SEM has been applied to develop many health programs, such as community-based interventions to increase physical activity (Peterson *et al*, 2002; Elder *et al*, 2007; Cochrane and Davey, 2008), programs to prevent HIV/AIDS (Laver *et al*, 2005-2006) and drug abuse (Sanders, 2000). To our knowledge, there are no explicit reports of the SEM being applied to oral health program development.

The aims of this study were to demonstrate the application of the SEM to oral health interventions and to evaluate its effects on oral health practices among caregivers and their determinants at multiple levels. The process of the implementation was critically examined in order to explain the results and help develop programs in the future.

## MATERIALS AND METHODS

### Study design and population

A quasi-experimental design (Creswell, 1994) was employed to evaluate the effectiveness of a 1-year multi-level intervention program to change caregiver behaviors and multi-level determinants. Two districts in Chon Buri Province, Thailand, with 4 sub-districts per district, participated. The criteria for choosing control and experimental sites were based on a comparable population structure, caries prevalence, and no existing oral

health programs at the health centers. Four sub-districts in the experimental group received a multi-level intervention and four sub-districts in the control group received routine health services from local health centers, and toothbrushes pre- and post-test.

The study population included caregivers of children aged 6-36 months, village health volunteers, called lay health workers (LHWs) in this study, and health center staff. Criteria for inclusion were the caregivers of that children would have no systemic diseases, and would routinely bring a child to the health center for vaccination. All LHWs and health center staff in the control and experimental sites were invited to participate in the study. Exclusion criteria were being unwilling to participate or unable to complete the questionnaire.

**Procedures**

This study was approved by the Ethics Committee on Human Research by the Mahidol University Institutional Review Board (MU-IRB). Written informed consent was obtained from all participants. Preparation phases included conducting a formative study by interviewing health center staff, meeting stakeholders, and group discussions with LHWs. The results from the formative study and the results of the meetings and group discussions were used to guide program planning.

Based on the formative study, the health center staff training focused on increasing awareness, perceived risk and severity of ECC, increase outcome expectations, and increased skill development. The training methods included using multi-media presentations to illustrate the characteristics of initial caries, the consequences and severity of ECC, demonstrating the use of fluoride drops and oral screening. The emphasis was on four important oral health behaviors: child tooth brushing, bottle feeding, controlling sugary snacks and use of a fluoride supplement.

The training objectives for LHWs were to increase knowledge regarding risks for and severity of ECC, knowledge regarding the four oral health behaviors, increase their skills for providing information, giving advice and encouraging caregivers to improve child's oral health care. LHWs participated in a one-day training workshop which was divided into four different activities designed to cover the learning objectives. The methods included multi-media presentations, demonstrations, and role play. The LHWs training was carried out by the researcher, a dentist and three dental hygienists from the district hospital and two volunteer dentists from the provincial health office.

**Program description**

The program was designed to address the determinants of behaviors at the intrapersonal, interpersonal, organizational and community levels based on the SEM. Theoretical constructs from the Self-efficacy Theory, Health Belief Model (HBM) and concepts from the Social Support and Organizational Change Theory were used to guide intervention development and measurement. The program consisted of 3 main components: 1). Oral health education and services at health centers. Health center staff provided four main oral health activities including dental screening, structured oral health education, prescribing fluoride supplements, and giving a toothbrush/and or toothpaste to caregivers every 3 months at vaccination visits; 2). Home visits by LHWs to provide social support for caregivers. Trained LHWs visited caregivers every 3

months to follow-up on oral health practices. These visits focused on three areas of social support: informational, appraisal, and emotional support for caregivers; 3). Community mobilization process. Members of the Tambon Administrative Organization, day care teachers and village health volunteers were invited to meetings during the program. Members of the community were educated about the problem of ECC. Group discussions were conducted to allow representatives from community groups to better understand ECC and its prevention in community.

**Program evaluation**

Outcomes were evaluated by self-administered questionnaires and oral examination before and after the intervention. Two dental hygienists conducted standardized children's oral health examinations and collected data using questionnaires. The inter-examiner reliability was satisfactory pre- and post-test (k = 0.861 and 0.903). Dental caries were recorded using the following criteria:

U = Unerupted tooth; tooth has not yet erupted, or erupted showing less than $^1/_2$ of the tooth surface for anterior teeth, or the buccal contour is not visible for posterior teeth. S = Sound tooth; normal enamel surface, no restoration. d1 = Initial caries/caries limited to enamel; the lesion is whitish or yellowish, opaque with or without a micro-cavity but no softened floor/wall: d2 = Caries to dentine and beyond; cavitated lesion is seen to extend beyond enamel. It catches the probe with softened floor/wall of undermined enamel, and includes a deep lesion with probable pulpal involvement. m = Missing teeth due to caries. f = Filled surface without evidence of secondary caries.

The dmft scores were calculated by combining d1, d2, m, and f to assess the severity of caries in the child.

Process evaluation utilized both quantitative and qualitative methods. Group discussions were conducted with health center staff and LHWs to assess barriers and facilitators during program implementation. Group discussions were tape-recorded and coded for emerging themes. Quantitative data were collected every three months by the researcher, assisted by dental hygienists through site visits, structured observations, health center logs and LHW reports. The quantitative measures were modified from Steckler and Linnan (2002): Reach- referring to the percentage of caregivers who attended the program at the health center and received a home visit; Dose-delivered- referring to the percentage of each program component actually delivered to participants; and Fidelity- referring to the percentage of core activities conducted.

**Data analysis**

The data were analyzed using SPSS version 16.0. (SPSS; Chicago, IL). Descriptive statistics and non-parametric tests including independent and dependent sample tests were employed to compare differences in children's dental caries, caregiver behavior, and multi-level factors at baseline and after intervention between the control and experimental groups. Transcriptions from group discussions were analyzed to identify patterns among subjects. Content analysis was employed to identify barriers and facilitating factors at study sites.

## RESULTS

**Characteristics of samples**

Table 1 shows the characteristics of caregivers and children in this study. One hundred fourteen of 177 pairs of children

Table 1
Characteristics of caregivers and children.

| Characteristics | Control group ($N = 52$) $n$ (%) | Experimental group ($N = 62$) $n$ (%) | $p$-value |
|---|---|---|---|
| Child's ages (months) | | | NS |
| 6-12 | 18 (34.6) | 23 (37.1) | |
| 13-24 | 22 (42.3) | 28 (45.2) | |
| 25 -36 | 12 (23.1) | 11 (17.7) | |
| Mean ± SD | 18.00 ± 9.30 | 19.16 ± 8.74 | NS |
| Range | 6 - 36 | 6 - 36 | |
| Caregiver's age (years) | | | NS |
| Mean ± SD | 34.50 ± 11.52 | 31.74 ± 10.61 | |
| Range | 17 - 65 | 16 - 63 | |
| Relationship of caregiver to child | | | NS |
| Mother | 36 (69.2) | 46 (74.2) | |
| Father | 3 (5.8) | 2 (3.2) | |
| Grandparent | 10 (19.2) | 10 (16.1) | |
| Other | 3 (5.8) | 4 (6.5) | |
| Caregiver education | | | NS |
| Elementary school or less | 25 (48.1) | 26 (41.9) | |
| Junior high school | 13 (25.0) | 11 (17.7) | |
| High school | 6 (11.5) | 16 (25.8) | |
| Diploma/Bachelor's degree | 8 (15.4) | 9 (14.5) | |
| Family's income (Baht per month) | | | NS |
| <5,000 | 19 (36.5) | 15 (24.2) | |
| 5,000-9,999 | 17 (32.7) | 26 (41.9) | |
| 10,000-14,999 | 10 (19.2) | 13 (21.0) | |
| ≥15,000 | 6 (11.5) | 8 (12.9) | |
| Maternal occupation | | | * |
| Agriculture | 3 (5.8) | 1 (1.6) | |
| Employee | 30 (57.7) | 28 (45.2) | |
| Unemployed | 8 (15.4) | 28 (45.2) | |
| Others | 11 (21.2) | 5 (8.1) | |
| Paternal occupation | | | NS |
| Agriculture | 4 (7.7) | 1 (1.6) | |
| Employee | 35 (67.3) | 51 (82.3) | |
| Unemployed | 3 (5.8) | 2 (3.2) | |
| Others | 10 (19.2) | 8 (12.9) | |

*Chi-square, $p<0.01$

and their caregivers were followed up at one year: 52 and 62 pairs from the control and experimental groups, respectively. The two groups had similar characteristics in children's ages and genders, family incomes, paternal occupations, oral health status, relationship of caregiver to child, caregiver age, and caregiver education

Table 2
The oral health status of children in control and experimental groups.

| Child's oral health status | | Control group | Experimental group | *p*-value |
|---|---|---|---|---|
| Caries (%) | Before | 34.7 | 47.6 | 0.107[a] |
| | After | 63.6 | 60.7 | 0.741[a] |
| dmft (Mean ± SD) | Before | 2.22 ± 4.26 | 2.34 ± 3.81 | 0.283[b] |
| | After | 3.49 ± 3.97 | 3.04 ± 3.90 | 0.993[b] |

[a] Chi-square test; [b] Mann-Whitney *U* test

levels. Maternal occupation was significantly different between the control and experimental groups ($p<0.01$).

**The effects of the intervention on dental caries**

At baseline, 76.9% and 69.4% of children in the control and experimental groups, respectively, had tooth eruption ($p>0.05$). After intervention, all children in the control and experimental groups had tooth eruption. Among children who had tooth eruption, 34.7% of children in the control group had dental caries compared to 47.6% in the experimental group ($p>0.05$). After intervention, the prevalences of dental caries were 61.5% and 64.5% of children in the control and experimental groups, respectively. Children in both the control and experimental groups had increases in dental caries from baseline; there were no differences in caries prevalence and dmft scores between the control and experimental groups after intervention ($p>0.05$). Table 2 shows the oral health status of children in both the control and experimental groups.

**Effect of intervention on oral health practices**

**Tooth brushing/cleaning.** Table 3 shows the caregiver's report of the child's oral health practices. Tooth brushing significantly increased in both the control and experimental groups ($p<0.001$). After intervention, 80.8% and 93.5% of caregivers in the control and experimental groups, respectively, reported their child brushed their teeth ($p<0.05$). Adult supervised teeth brushing were reported in 40.4% and 50.0% of caregivers in the control and experimental groups at baseline, respectively. After intervention, this increased to 85.7% and 91.4% in the control and experimental groups, respectively ($p>0.05$).

The use of fluoride toothpaste was reported as 32.7% and 30.6% in the control and experimental groups at baseline, respectively. After intervention, caregivers in the experimental group had a significant greater increase in the use of fluoride toothpaste than the control group ($p<0.001$). After intervention, toothpaste was used by 59.6% and 89.5% in the control and experimental groups, respectively ($p<0.01$).

**Bottle feeding.** Caregivers reported 28.8% and 35.5% of children in the control and experimental groups fell asleep with a bottle in their mouths during the previous week at baseline. After intervention, 28.8% and 32.3% were reported to have fallen asleep with a bottle in their mouths ($p>0.05$). At baseline, 23.1% and 27.4% of caregivers in the control and experimental groups, respectively, reported putting

Table 3
The caregiver reports of child's oral health practices.

| Oral health practice | Control group (*N*=52) | | Experimental group (*N*=62) | | *p*-value (Chi-square) |
|---|---|---|---|---|---|
| Child's tooth brushing | | | | | |
| Any tooth brushing during the previous week | | | | | |
| Before | 23 | 45.1% | 37 | 59.7% | 0.122 |
| After | 42 | 80.4% | 58 | 93.5% | 0.035 |
| *p*-value [a] | | <0.0001 | | <0.0001 | |
| Brushing with adult supervision | | | | | |
| Before | 21 | 40.4% | 31 | 50.0% | 0.987 |
| After | 36 | 85.7% | 53 | 91.4% | 0.348 |
| *p*-value [a] | | 0.250 | | 0.900 | |
| Use fluoride toothpaste | | | | | |
| Before | 17 | 32.7% | 19 | 30.6% | 0.083 |
| After | 31 | 59.6% | 53 | 85.5% | 0.031 |
| *p*-value [a] | | 0.500 | | <0.0001 | |
| Bottle feeding | | | | | |
| Falling asleep with bottle | | | | | |
| Before | 15 | 28.8% | 22 | 35.5% | 0.696 |
| After | 15 | 28.8% | 20 | 32.3% | 0.648 |
| *p*-value [a] | | 0.687 | | 0.581 | |
| Putting sweeten milk, juice or soda in the bottle | | | | | |
| Before | 12 | 23.1% | 17 | 27.4% | 0.863 |
| After | 17 | 32.7% | 19 | 30.6% | 0.818 |
| *p*-value [a] | | 0.227 | | 0.383 | |
| Use of fluoride supplement | | | | | |
| Before | 6 | 13.0% | 15 | 25.4% | 0.116 |
| After | 7 | 13.7% | 49 | 80.3% | <0.0001 |
| *p*-value [a] | | 0.990 | | <0.0001 | |

[a] McNemar test

sweet drinks in the child's bottle; after intervention, there was no significant change in these percentage (32.7% and 30.6%; $p>0.05$).

**Use of fluoride supplement.** Fluoride supplementation was reported in 9.6% of the control group and 11.3% in the experimental group at baseline ($p>0.05$). After intervention, the use of fluoride supplementation reported to be 7.7% and 61.3% ($p<0.001$) among the control and experimental groups, respectively.

**Snack consumption.** Table 4 shows the caregiver reported consumption of very high, high, moderate, and low cariogenic snacks by children. The levels of cariogenicity were based on a previous study of dental plaque pH of various snacks in Thailand (Wongkongkathep, 1999). A reported consumption of very high and high cariogenic snacks was more common in experimental group at baseline ($p<0.05$). The consumptions of moderate and low risk snacks were not

Table 4
The caregiver report of child's snack consumption in the previous week.

| | Control group (*N*=52) | | | Experimental group (*N*=62) | | | *p*-value (Chi-square) |
|---|---|---|---|---|---|---|---|
| | None | ≤ 4 days | >4 days | None | ≤4 days | >4 days | |
| Very high risk | | | | | | | |
| Before | 67.3 | 30.8 | 1.9 | 43.5 | 43.5 | 12.9 | 0.014[b] |
| After | 38.5 | 51.5 | 9.6 | 33.2 | 59.7 | 8.1 | 0.708 |
| *p*-value[a] | | | 0.001[c] | | | 0.450 | |
| High risk | | | | | | | |
| Before | 25.0 | 61.5 | 13.5 | 12.9 | 54.8 | 32.3 | 0.035[b] |
| After | 3.8 | 73.1 | 23.1 | 1.6 | 80.6 | 17.7 | 0.564 |
| *p*-value[a] | | | 0.004[c] | | | 0.695 | |
| Moderate risk | | | | | | | |
| Before | 21.2 | 48.1 | 30.8 | 14.5 | 43.5 | 41.1 | 0.408 |
| After | 1.9 | 48.1 | 50.0 | 3.2 | 64.5 | 32.3 | 0.155 |
| *p*-value[a] | | | 0.004[c] | | | 0.857 | |
| Low risk | | | | | | | |
| Before | 11.5 | 28.8 | 59.6 | 8.1 | 35.5 | 56.5 | 0.675 |
| After | 1.9 | 32.7 | 65.4 | 0.0 | 53.2 | 46.8 | 0.058 |
| *p*-value[a] | | | 0.185 | | | 0.869 | |

[a] Wilcoxon signed-rank test;[b]Chi-square test, $p<0.05$; [c]Wilcoxon signed-rank test, $p<0.01$
Very high risk=Chocolate and candy; High risk=Bread, crispy snack, Thai dessert; Moderate risk= Jelly, ice-cream, yogurt drink, juice, soda; Low risk=Fruits, beans

significantly different between the control and experimental groups at baseline ($p>0.05$).

The consumption of all groups of snacks by both groups did not change significantly after intervention ($p>0.05$); however, the consumption of very high, high, and moderate cariogenic snacks significantly increased among children in the control group after intervention ($p<0.01$). The consumptions of very high, high and moderate cariogenic snacks did not change significantly after intervention in the experimental group ($p>0.05$). The consumption of low cariogenic snacks did not change significantly in either group after intervention ($p>0.05$).

**The effects of the intervention on intrapersonal factors**

**Knowledge**. At baseline, the mean knowledge scores were 3.94 and 3.93 out of 10 in the control and experimental groups, respectively ($p>0.05$), and after intervention, the mean scores were 4.73 and 6.29. The knowledge scores were significantly higher among caregivers in the experimental group than caregivers in the control group after intervention ($p<0.001$). All areas of knowledge improved significantly ($p<0.05$) among caregivers in the experimental group (Table 5).

**Attitudes towards oral health behavior.** Intervention significantly increased at-

Table 5
The correct responses to each knowledge item among caregivers.

| Oral health knowledge items | Control group (*N*=52) | Experimental group (*N*=62) | *p*-value (Chi-square) |
|---|---|---|---|
| Age to start cleaning child's teeth | | | |
| Before | 17.3% | 21.0% | 0.622 |
| After | 15.4% | 30.6% | 0.056 |
| *p*-value[a] | 0.705 | 0.021 | |
| Method of using fluoride supplement | | | |
| Before | 13.5% | 9.7% | 0.527 |
| After | 13.5% | 57.6% | <0.0001 |
| *p*-value[a] | 1.000 | <0.0001 | |
| Should not put juice in the bottle | | | |
| Before | 28.8% | 33.9% | 0.535 |
| After | 34.6% | 66.1% | 0.001 |
| *p*-value[a] | 0.439 | 0.004 | |
| Cariogenic snack | | | |
| Before | 25.0% | 21.0% | 0.609 |
| After | 28.8% | 41.9% | 0.147 |
| *p*-value[a] | 0.791 | 0.021 | |

[a]McNemar test

titudes about the use of fluoride supplementation and children sleeping with a bottle among caregivers in the experimental group. After intervention, 76.9% and 93.3% of caregivers in the control and experimental groups, respectively, agreed that giving fluoride supplementation was important to prevent caries in children ($p<0.05$). Positive attitudes toward not putting a child to sleep with a bottle were reported in 58.8% and 78.8% in the control and experimental groups, respectively ($p<0.05$).

**Outcome expectation and self-efficacy.** Caregivers in the experimental group had a significantly increase their outcome expectation of giving fluoride supplement ($p<0.05$). After intervention, 90.0% of caregivers in the experimental group and 73.1% in the control group agreed giving fluoride supplement would prevent their child from having caries. After intervention, the self-efficacy of giving fluoride supplementation was significantly higher in the experimental group ($p<0.01$).

**Effect of the intervention on interpersonal factors.** Table 6 shows the changes in caregiver responses about receiving social supports. The perceived social support received from health center staff at baseline were 18.0% and 19.3% among caregivers in the control and experimental groups, respectively. After intervention, caregivers in the experimental group reported receiving significantly greater social support from LHWs and health center staff ($p<0.001$). The greatest social support received from LHWs was reported as providing information (83.9%), and the least was emotional support (67.2%). The greatest social support from health center staff was reported as providing informa-

Table 6
The percentage of caregivers reported receiving social supports from different sources during the past 6 months before and after intervention.

| | Control group (*N*=52) | | | | Experimental group (*N*=62) | | | |
|---|---|---|---|---|---|---|---|---|
| | LHW | HC | HP | DT | LHW | HC | HP | DT |
| Informational support | | | | | | | | |
| Before | 6.1 | 18.0 | 6.1 | 0.0 | 5.3 | 19.3 | 10.5 | 1.8 |
| After | 9.6 | 19.2 | 11.5 | 3.8 | 83.9[a] | 71.4[a] | 19.6 | 7.1 |
| Appraisal support | | | | | | | | |
| Before | 4.2 | 14.3 | 6.2 | 0.0 | 5.3 | 14.0 | 8.8 | 1.8 |
| After | 3.8 | 13.5 | 5.8 | 1.9 | 71.2[a] | 45.8[a] | 6.8 | 6.8 |
| Emotional support | | | | | | | | |
| Before | 6.2 | 6.1 | 4.1 | 0.0 | 5.3 | 8.8 | 5.3 | 1.8 |
| After | 5.8 | 5.8 | 3.8 | 3.8 | 67.2[a] | 53.4[a] | 8.6 | 8.6 |
| Instrumental support | | | | | | | | |
| Before | 4.2 | 8.2 | 6.2 | 0.0 | 1.8 | 15.8 | 10.5 | 1.8 |
| After | 3.8 | 17.3 | 9.6 | 1.9 | 76.3[a] | 69.5[a] | 3.4 | 1.7 |

[a]McNemar test, $p<0.001$
LHW, social support received from lay health workers; HC, social support received from health center staff; HP, social support received from hospital staff; DT, social support received from dental care providers

tion (71.6%), and the least was reported as appraisal support after intervention (45.8%). The social support reported as being received by caregivers in the control group did not significantly change after intervention ($p>0.05$).

**Effect of the intervention on organizational factors**

The intervention had an effect on the determinants at the organizational level. Fig 1 shows the percentage of health center staff reported providing oral health services at the health center. Giving toothbrushes and prescribing fluoride supplements for children increased in the experimental group after intervention compared to the control group. Dental screening increased slightly and referrals were similar to those reported at baseline in both groups. The service of providing fluoride supplements and toothbrushes was integrated into the well-baby clinic protocol after program implementation.

**Effect of multi-level intervention in the community**

The multi-level intervention increased participation of community groups, including LHWs, day care teachers, and local administrative organizations in child's oral health promotion. The activities that indicate agreement to support early childhood caries prevention include collaboration among LHWs, health centers and dental teams from district hospitals in promoting child oral health care in day care centers and health center requests for financial support for oral health equipment and materials from the LAO. By the end of the program implementation there

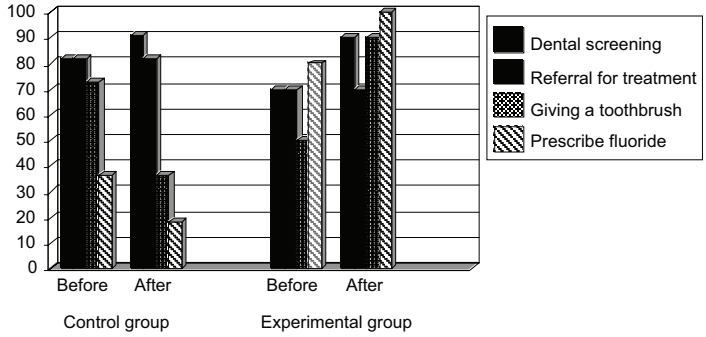


Fig 1–Percentage of health center staff providing oral health services.

was agreement among LHWs, health centers and dental department staff from the district hospital to apply this program to the rest of the tambons (sub-districts) in this district. LHWs and health center staff were invited to share their experiences with and give suggestions to improve the program in the future.

**The results of process evaluation**

Oral health services at health centers, and home visits by LHWs, were monitored during the program. The program was not fully implemented as planned. Fifty-six point eight percent of caregivers were reached at the health centers and 72.7% were reached by home visits. The health center staff and LHWs did not deliver all components of the program. The core activities of the health center component were delivered at 8.3% to 66.7% in different health centers. Giving toothbrushes and prescribing fluoride supplements were the activities carried out the most. Referral was the activity carried out the least by health center staff. Informational and emotional supports were reported by 72.7% of LHWs and appraisal support was reported by 28.4% of LHWs.

The barriers to providing oral health education and services included time constraint during vaccination, limited and changing personnel, unavailable fluoride supplements and unclear criteria of referral. The consistent themes that emerged from group discussions were lack of time and human resources, system coordination, and lack of ownership. Barriers to home visits component included conflicting beliefs of LHWs regarding prolonged bottle use, beliefs about the adverse effects of fluoride and the limited knowledge and skill about how to tell caregivers about healthy snack consumption.

The factors that facilitated the program implementation were the confidence of LHWs and health center staff after training, positive feedback from caregivers, and the availability of resources, such as brochures, toothbrushes and toothpastes. The health center staff identified LHWs were the facilitators of program implementation.

## DISCUSSION

The multi-level intervention significantly increased tooth brushing and the use of toothpaste and fluoride supplements by children in this study. Although reports of tooth brushing increased significantly in both control and experimental groups, tooth brushing was significantly higher in the experimental group ($p<0.05$). The increased tooth brushing by children in both groups can be explained by increasing age and number of teeth erupted among the children during program implementation. The intervention did not significantly affect bottle feeding behavior or consumption of snacks among children in this study. These results are similar to a previous study (Vachirarojpisan *et al*,

2005). The intervention also did not affect outcomes in terms oral health and carries.

Previous oral health programs have successfully promoted healthy bottle feeding (Davies *et al*, 2005). Besides toothbrushes, toothpaste, and leaflets, the program also gave out training cups to caregivers in order to support the weaning from bottles and using the training cup for juices. If the caregivers did not attend the health center, the program sent these items to them by mail. Oral health promotion programs aimed at changing behavior need to provide supports targeting health behavior. The importance of support to facilitate change in behavior was evident in this study: toothbrushes, toothpastes, and fluoride supplement were provided to caregivers; the use of toothpaste and fluoride supplements improved significantly after the intervention.

While children in experimental group did not change their snack consumption, those in the control group significantly increased their consumption of very high, high, and moderate risk snacks after intervention ($p<0.01$). The intervention may have curbed snack consumption but did not reduce consumption of cariogenic snacks. However, baseline data of children in the experimental group showed a high consumption of very high, high, and moderate cariogenic snacks.

This program increased the use of toothpaste and fluoride supplements and intrapersonal factors specific to these behaviors improved accordingly. The knowledge and attitudes regarding fluoride supplementation increased significantly among caregivers in the experimental group, but not the control group after program implementation. The mean knowledge score among caregivers in the experimental group was <70%. The results may have several causes. There may have been a number of caregivers who were not reached by the program, as reflected by the fact that only 56.8% and 72.7% of caregivers were reached by health center and home visits, respectively. Persons who delivered program may not have emphasized the same areas of knowledge, thus many caregivers incorrectly responded to these questions. Self-efficacy of caregivers related to controlling snack behavior was the lowest of all behaviors. This indicates many caregivers did not believe that controlling snacks would prevent caries, and caregivers were unable or unwilling to control their child's snack consumption. As a result, there was no significant difference in changes of snack consumption among children in the two groups after intervention.

During program implementation, the researcher did not have direct contact with caregivers, except during pretest and posttest data collection. Caregivers received oral health education and support from LHWs, health centers, and members in the community. Thus, the significant increase in social support from LHWs and health center staff points out the interpersonal factors in changing oral health practices among caregivers.

At the organizational level, changes in health center services explain the effects on caregiver behavior in increasing tooth brushing and use of fluoride supplements. The effect of the health center was demonstrated by both the indirect effect of caregivers reporting receiving social supports from health center staff and the direct effect of caregiver intrapersonal factors and their behavior. However, changing an organization requires supports from the community and administration. The involvement of local organizations is critical to maintain oral health activities at health centers and in communities. The

program allowed local organizations to be aware of ECC, and become the channel for financial support to health centers and the community in long term.

Our results indicate the importance of policies to regulate and reinforce oral health preventive services at health centers. Future research focusing on oral health policies at the district, provincial and national levels is needed to produce an impact at the community and policy levels.

Planning oral health promotion programs with multiple components is intuitive without using the social and behavioral theories. In this study, SEM and behavioral theories were utilized to systematically guide program planning and evaluation. The evaluation of relationships of multi-level determinants in a larger scale using the multi-level analysis is essential to better understand the interactions among determinants at multiple levels. The types of designs testing the combined effects of multilevel interventions compared to single-level approaches are needed to demonstrate the effectiveness of multi-level approaches.

Our findings indicate determinants at multiple levels influence caregiver oral health practices. The application of the SEM was useful to identify the pathway for intervention. Process evaluation is critically important to explain the results of the outcome evaluation. Information from process evaluation can indicate actual levels of implementation and barriers to the program and it can be used to suggest modification for future intervention.

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## REFERENCES

Cochrane T, Davey R. Increasing uptake of physical activity: a social ecological approach. *J R Soc Health* 2008; 128: 31-40.

Creswell J. Research design: qualitative and quantitative approaches. Thousands Oaks: Sage Publication, 1994.

Davies GM, Duxbury JT, Boothman NJ, Davies RM, Blinkhorn AS. A staged intervention dental health promotion programme to reduce early childhood caries. *Community Dent Health* 2005; 22: 118-22.

De Grauwe A, Aps J, Martens L. Early Childhood Caries (ECC): what's in a name? *Eur J Paediatr Dent* 2004; 5: 62-70.

Department of Health, Ministry of Public Health. The 6th National Oral Health Survey in Thailand 2006-2007. Nonthaburi: Ministry of Public Health, 2007. [Cited 2010 Dec 6]. Available from: URL: http://dental.anamai. moph.go.th/index2.php

Elder JP, Lytle L, Sallis JF, *et al*. A description of the social-ecological framework used in the trial of activity for adolescent girls (TAAG). *Health Educ Res* 2007; 22: 155-65.

Evans C, Kleinman D. The Surgeon General's report on America's oral health: opportunities for the dental profession. *J Am Dent Assoc* 2000; 131: 1721-8.

Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR. Early

childhood caries and quality of life: child and parent perspectives. *Pediatr Dent* 2003; 25: 431-40.

Laver S, van der Borne B, Kok G. Using theory to design an intervention for HIV/AIDS prevention in farm workers in rural Zimbabwe 1994-95. *Int Q Community Health Educ* 2005-2006; 25: 135-48.

McLeroy K, Bibeau D, Steckles A, Glaz K. An ecological perspective on health promotion programs. *Health Educ Q* 1988; 15: 351-77.

Peretz B, Ram D, Azo E, Efrat Y. Preschool caries as an indicator of future caries: a longitudinal study. *Pediatr Dents* 2003; 25: 114-8.

Peterson K, Sorensen G, Pearson M, Hebert J, Gottlieb B, McCormick M. Design of an intervention addressing multiple levels of influence on dietary and activity patterns of low-income, postpartum women. *Health Educ Res* 2002; 17: 531-40.

Sallis JF, Owen N. Ecological models of health behavior. In: Glanz K, Rimer BK, Lewis FM, eds. Health behavior and health education: theory, research, and practice. 3rd ed. San Francisco: Jossey-Bass, 2002: 462-84.

Sanders M. Community-based parenting and family support interventions and the prevention of drug abuse. *Addict Behav* 2000; 25: 929-42.

Steckler A, Linnan L. Process evaluation for public health interventions and research. 1st ed. Sanfrancisco: Jossey-Bass, 2002.

Vachirarojpisan T, Shinada K, Kawaguchi Y. The process and outcome of a programme for preventing early childhood caries in Thailand. *Community Dent Health* 2005; 22: 253-9.

Vachirarojpisan T, Shinada K, Kawaguchi Y, Laungwechakan P, Somkote T, Detsomboonrat P. Early childhood caries in children aged 6-19 months. *Community Dent Oral Epidemiol* 2004; 32: 133-42.

Wadhawan S, Kumar JV, Badner VM, Green EL. Early childhood caries-related visits to hospitals for ambulatory surgery in New York State. *J Public Health Dent* 2003; 63: 47-51.

Wongkongkathep S. A comparison of effects of 12 extrinsic sugared snacks on dental plaque pH in primary school children in Lopburi Province. *J Dent Assoc Thai* 1999; 49: 104-12.