

EVALUATION OF ONE YEAR WORKPLACE ORAL HEALTH PROMOTION PROGRAM IN FACTORIES

Haruthai Sukcharoenkosol^{1,2}, Thongchai Vachirarojpisan³,
Sudaduang Krisdapong^{1,*}

¹ Department of Community Dentistry, Faculty of Dentistry, Chulalongkorn University, Bangkok, 10330, Thailand

² Fang Hospital, Chiang Mai, 50110, Thailand

³ The Dental Council, Thailand

ABSTRACT:

Background: The prevalence of oral diseases among Thai adults is constantly high. Oral health promotion programs rarely target adult groups. This study implemented a one year oral health promotion program in workplaces with the aim of improving knowledge, behaviors and the state of oral health in adult workers.

Methods: A total of six factories (191 workers) in Kaengkhohi district, Saraburi province, Thailand participated in the project. Select employees in three factories (92 workers) were designated to be in the control group. Select employees in two factories (69 workers) were designated to be in the Intervention I group lasting 1 year while employees in one factory (30 workers) were designated to be in the Intervention II group lasting a 6 month period. The two intervention groups were individually interviewed, and later discussed in group to design and create their own oral health-related activities. Oral health promotion activities occurring in the intervention I group included posters, morning talks, being reminded by headworkers to brush teeth after lunch and encouragement to reduce snacking during breaks. The Intervention II group only displayed education posters. No activities or educational material were supplied to the control group. Oral examinations, interview questionnaires to assess knowledge and behaviors were conducted at baseline, 6 months and 1 year periods. Data was compared for changes over the study period within all the three groups using Wilcoxon Signed Rank and Mc-Nemar tests, and changes between the control and the intervention groups were assessed using Mann-Whitney U and Chi-square tests.

Results: At the 6th month, the intervention I group improved knowledge and behaviors relating to frequency and duration of toothbrushing, type of toothpaste, food consumption habits and self-examination. At the end of the 1-year period, improvements of the intervention I group remained regarding duration of toothbrushing, type of toothpaste used and consumption habit. The intervention II group improved knowledge and behaviors for frequency of toothbrushing, consumption habit and self-examination. Comparing changes between the intervention I/II and the control group, intervention I group had significantly better improvement in knowledge regarding duration of tooth brushing and in behaviors regarding type of toothpaste, recommended drinks, dental examination and mouth rinse use. Intervention II group showed significantly better behavioral improvements on frequency of tooth brushing and dental examination.

Conclusion: A one year workplace oral health promotion program with a combination of education and community-initiated oral health activities improved oral health knowledge and behaviors of factory workers.

Keywords: Workplace environment; Health education; Oral health; Oral health promotion

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INTRODUCTION

Oral health status of Thai adults has been almost unchanged during the past decade. The prevalence

* Correspondence to: Sudaduang Krisdapong
E-mail: Sudaduang.K@chula.ac.th

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of dental caries among Thai adults in 2002 was 86% and ten year later, in 2012 was 87% [1, 2]. For gingival and periodontal health, the prevalence of disease was 98% in 2002 and decreased a little to 86% in 2012 [1, 2]. The almost steady and relatively high oral diseases might relate to the fact that oral health promotion programs rarely target at adults groups as compare to other age groups [3]. To decrease oral diseases, programs should aim at the improvement of oral health behaviors which includes toothbrushing practice, use of fluoride toothpaste, dietary pattern and self-oral examination as well as dental service attendances [4-7].

Previous oral health programs on adults were mainly education-based programs and oral health service provisions such as free oral examination accompanied with oral health education [8], preventive care packages including oral prophylaxis, pit and fissure sealant, fluoride therapy, provisions of oral hygiene aids and educational pamphlets [9, 10], subsidization for oral health services [11]. Such programs were comparable to two out of the five elements of Ottawa Charter for health promotion, namely, developing personal skills and re-oriented health services [12]. The other three elements which are creating health-related policy and supportive environments as well as strengthening community actions were rarely applied to oral health programs for adults.

Previous study on children age group showed that building healthy policy and creating healthy environments in schools improved children's oral health behaviors [13]. Similar programs on adults' workplaces have never been reported. Therefore, this study applied various strategies of oral health promotion to the adults' oral health program in workplaces. The program included oral health education and attempts to strengthen community actions to create oral health-related activities and supportive environment. Oral health knowledge, behaviors and oral hygiene status of workers were evaluated after one year, comparing between those receiving and not receiving the program.

METHODS

This was a control trial community research, implementing a one year oral health promotion project in workplaces in Kaengkhoi district, Saraburi province, Thailand. Settings were factories in the whole district of which the total number was 269 factories. Since the study required long term participation from factories, inclusion criteria was

medium and small factories (number of workers not exceed 200), while exclusion criteria was joint factories because some workers and facilities were shared. Only six factories in the area reached the inclusion criteria, accepted invitation and were randomly divided into the control and the intervention groups. We invited all workers in participating factories as study sample. The control group did not participate our oral health promotion project. The intervention I group joined the project since beginning, thus duration of project participation was 1 year. The intervention II group joined the project 6 months later. Sample size was calculated using findings from a previous similar study [14] that implemented 6 weeks oral health program in workplace and reported a difference of 23% in gingivitis between the intervention (25%) and the control (48%) groups after the program. Using power of 80% and 10 % error, a size of 73 workers would be required for each group, thus the total would be 219 workers. This study was approved by the Ethical Committee of the Faculty of Dentistry, Chulalongkorn University (approval No. HREC-DCU 2013-024).

Study's procedure of implementing oral health promotion project followed Watt, et al.'s framework [15]. We used various actions such as stimulation, empowerment, facilitation, education, advocacy in order to motivate the intervention groups and subsequently, make oral health-related policy and activities happen in their factories. In details, factory managers were interviewed and motivated, 4 times during 1 year period, about their factory's characteristics. In addition, group discussions with positive approach [16] were conducted. Group discussions were arranged once for each factory, aiming to gain community participation and strengthen their action in taking control of their oral health [12]. Finally, the groups reach agreements on creating oral health-related policy, environments or activities. Through using community participation approach, participating factories initiated various oral health promotion activities. Activities of the intervention I group were posters and morning talks. Morning talk, given once every two week throughout a year, was not only to giving oral health message to workers but also to persuade all workers to brush their teeth after lunchtime. Head workers also accepted they would remind their workers to brush their teeth after lunch every day. In addition, a regulation on limiting snacks and sweetened drinks consumption was set up, that is, workers were

allowed to take snacks and sweetened drinks only at after 10.00 am., during morning and after 3.00 pm. during afternoon. For the intervention II group, activities were less extensive than the first group. Only posters on dental health education were displayed in the factory areas.

Data collected were oral hygiene status, oral health knowledge and behaviors. Data were collected 3 times (baseline, 6 months and 1 year periods) for the control and the intervention I group, and 2 times (baseline and 1 year period) for the intervention II group by one dentist and four interviewers. All of them were blinded, did not involve in the process of project implementation. Training and calibration sessions were conducted to standardize the dentist and four interviewers. The dentist was trained and tested her inter-reliability ($\kappa = 0.68$) against gold standard who was a head of dental public health department in the district and was one of the dental examiners in the national oral health survey team. Intra-examiner reliability of the dentist was also tested ($\kappa = 0.85$). Oral examination was conducted under natural daylight to assess oral hygiene status of workers. Oral Hygiene Index Simplified (OHI-S) index [17] was used. Oral hygiene status was categorized into good (OHI-S score = 0-1.2), fair (OHI-S score= 1.3-3.0) and poor (OHI-S score 3.1-6.0). Intra-examiner reliability was tested during a pilot study showing almost perfect almost perfect agreement with Kappa statistics of 0.85. Oral examination was conducted for all workers in the control, the intervention I and the intervention II groups. During oral examination, workers were able to consult dentist on their oral health problem.

Knowledge and behaviors questionnaire was developed through an extensive review on previous studies on this field and standard questionnaires used in national oral health surveys. The questionnaire was sent to three experts who specialized on this area for their comments, and later adjusted accordingly. Interviewed questionnaire contained twelve items of oral health knowledge and thirteen items on oral health behaviors. Knowledge related to following 11 aspects: 1) frequency of toothbrushing (at least twice per day), 2) duration of toothbrushing (at least two minutes), 3) type of toothpaste (fluoride containing), 4) benefit of using mouth rinse (anti-cariogenic and anti-microbial effect not recommend for daily use for all people), 5) benefit of using fluoride mouth rinse (anti-cariogenic effect, recommended for high risk

group), 6) frequency of meal (three meals per day), 7) eating vegetable with meals (recommended for every meals), 8) type of snacks recommended (fruit), 9) eating fruit habit (not recommend grazing/ continually consume all day), 10) recommended drinks (plain water or drink does not contain non-milk extrinsic sugar [18], 11) self-examination (recommended for detecting oral abnormality). Behavioral items were parallel to knowledge items with an additional item on whether or not, you have received oral examination by dentist (during one year period or since the project started). Each answer was dichotomous (right/wrong) and scored 0/1. Total score was the sum of all item scores. Data were analyzed using SPSS version 22 (IBM Corp., Armonk, NY, USA). Overtime changes in knowledge and behaviors of the three groups were analyzed, by comparing 6 month and 1 year periods with baseline using Wilcoxon Signed Ranks. In addition, comparisons of changed knowledge and behavior scores between the control and the intervention I as well as the control and the intervention II groups were performed using Mann-Whitney U test. For oral hygiene status, overtime changes were analyzed by comparing percentage of workers with good oral hygiene between 6 month, 1 year periods and baseline using McNemar test. Percentages of workers who improved to having good oral hygiene at the 6th month and one year periods were also compared between the control and the intervention groups using Chi-square test. Statistical significance was defined when $p \leq 0.05$.

RESULTS

Total number of sample was 191 worker (87.2 % response rate) dividing into 92 workers (from 3 factories) for control, 69 workers (from 2 factories) for intervention I and 30 workers (from 1 factory) for intervention II group. Number of sample was higher or about the required size (73 workers for each group) except for the intervention II group.

Knowledge

At 6th month period, knowledge improvement was observed in both intervention I and control groups (Table 1). The intervention I group had significantly higher knowledge scores when compared to baseline for 4 items: frequency of toothbrushing ($p=0.035$), duration of toothbrushing ($p<0.001$), type of toothpaste ($p=0.034$), and self-examination ($p=0.034$). The control group had significantly higher knowledge scores when compared to the baseline for 2 items: duration of

Table 1 Comparison of knowledge scores at each time point with baseline within each study group using Wilcoxon Signed Ranks test

Knowledge	Control (Mean±SD) (n=56)			Intervention I (Mean±SD) (n=47)			Intervention II (Mean±SD) (n=20)	
	Baseline	6 months	1 year	Baseline	6 months	1 year	Baseline	1 year
Frequency of tooth brushing	0.9±0.3	0.9±0.3 p=0.480 ¹	0.9±0.3 p=0.705 ²	0.7±0.5	0.9±0.4 p=0.035 ¹	0.9±0.4 p=0.052 ²	0.7±0.5	0.8±0.4 p=0.414 ²
Duration of tooth brushing	0.6±0.5	0.7±0.4 p=0.050 ¹	0.7±0.5 p=0.162 ²	0.3±0.5	0.7±0.5 p<0.001 ¹	0.7±0.5 p<0.001 ²	0.5±0.5	0.3±0.5 p=0.257 ²
Type of toothpaste	0.5±0.5	0.5±0.5 p=0.617 ¹	0.6±0.5 p=0.018 ²	0.4±0.5	0.5±0.5 p=0.034 ¹	0.6±0.5 p=0.013 ²	0.5±0.5	0.6±0.5 p=0.414 ²
Benefit of using mouth rinse	0±0.1	0±0.2 p=0.317 ¹	0.1±0.3 p=0.025 ²	0.1±0.3	0.1±0.3 p=0.317 ¹	0.1±0.2 p=0.564 ²	0.1±0.2	0.1±0.2 p=1.000 ²
Benefit of using fluoride mouth rinse	0.2±0.4	0.3±0.4 p=0.058 ¹	0.2±0.4 p=0.480 ²	0.2±0.4	0.2±0.4 p=0.655 ¹	0.3±0.4 p=0.257 ²	0.1±0.3	0.2±0.4 p=0.564 ²
Frequency of meal	0.9±0.3	1.0±0.2 p=0.257 ¹	1.0±0.2 p=0.257 ²	0.9±0.3	1.0±0.2 p=0.180 ¹	0.9±0.2 p=0.414 ²	0.7±0.5	0.9±0.4 p=0.180 ²
Eating vegetable with meals	0.6±0.5	0.7±0.5 p=0.248 ¹	0.7±0.5 p=0.593 ²	0.8±0.4	0.8±0.4 p=0.739 ¹	0.7±0.5 p=0.405 ²	0.5±0.5	0.8±0.4 p=0.034 ²
Type of snacks recommended	0.6±0.5	0.7±0.4 p=0.090 ¹	0.6±0.5 p=0.819 ²	0.7±0.5	0.6±0.5 p=0.439 ¹	0.6±0.5 p=0.317 ²	0.2±0.4	0.3±0.5 p=0.157 ²
Eating fruits habit	0.3±0.4	0.3±0.5 p=0.317 ¹	0.3±0.4 p=1.000 ²	0.2±0.4	0.1±0.3 p=0.739 ¹	0.2±0.4 p=1.000 ²	0.1±0.2	0.2±0.4 p=0.157 ²
Recommended drink	0.9±0.3	1.0±0.2 p=0.102 ¹	1.0±0.1 p=0.059 ²	0.8±0.4	0.8±0.4 p=1.000 ¹	0.9±0.2 p=0.034 ²	0.5±0.5	0.6±0.5 p=0.180 ²
Self-examination	0.6±0.5	0.8±0.4 p=0.018 ¹	0.8±0.4 p=0.008 ²	0.6±0.5	0.7±0.5 p=0.034 ¹	0.7±0.5 p=0.083 ²	0.4±0.5	0.7±0.5 p=0.034 ²
Total score	6.0±2.0	6.9±1.6 p=0.003 ¹	6.8±1.9 p=0.012 ²	5.6±1.7	6.4±1.8 p=0.001 ¹	6.5±1.9 p=0.001 ²	4.1±2.5	5.3±2.2 p=0.015 ²

¹ p-value of the comparison between 6 months and baseline

² p-value of the comparison between 1 year and baseline

Table 2 Comparing changed knowledge scores at the 6th month and 1 year periods of the intervention I and the intervention II with the control groups using Mann-Whitney U test

Knowledge	Control (Mean±SD)		Intervention I (Mean±SD)		Intervention II (Mean±SD)
	6 months (n=56)	1 year (n=56)	6 months (n=47)	1 year (n=47)	1 year (n=20)
Frequency of tooth brushing	0±0.4	0±0.4	+0.1±0.5 p=0.168	+0.1±0.5 p=0.116	+0.1±0.6 p=0.428
Duration of tooth brushing	+0.2±0.6	+0.1±0.7	+0.4±0.6 p=0.087	+0.4±0.6 p=0.048	-0.2±0.6 p=0.102
Type of toothpaste	0±0.5	+0.2±0.5	+0.1±0.4 p=0.365	+0.2±0.5 p=0.941	+0.1±0.6 p=0.583
Benefit of using mouth rinse	0±0.1	+0.1±0.3	0±0.1 p=0.901	0±0.3 p=0.045	0±0.3 p=0.264
Benefit of using fluoride mouth rinse	+0.1±0.4	0±0.4	0±0.3 p=0.243	0.1±0.4 p=0.709	0.1±0.4 p=0.885
Frequency of meal	+0.1±0.3	0±0.4	0±0.3 p=0.633	0±0.3 p=0.832	0.2±0.6 p=0.295
Eating vegetable with meals	+0.1±0.5	0±0.5	0±0.4 p=0.527	-0.1±0.5 p=0.327	+0.3±0.6 p=0.052
Type of snacks recommended	+0.1±0.5	0±0.6	-0.1±0.6 p=0.089	-0.1±0.6 p=0.374	0.1±0.3 p=0.578
Eating fruits habit	+0.1±0.5	0±0.5	0±0.4 p=0.366	0±0.5 p=1.000	+0.1±0.3 p=0.446
Recommended drink	+0.1±0.3	+0.1±0.3	0±0.4 p=0.339	+0.1±0.4 p=0.588	+0.2±0.5 p=0.514
Self-examination	+0.1±0.5	+0.2±0.5	+0.1±0.4 p=0.518	+0.1±0.5 p=0.612	+0.3±0.6 p=0.318
Total score	+0.9±2.2	+0.8±2.5	+0.8±1.7 p=0.819	+0.9±1.8 p=0.909	+1.2±2.1 p=0.620

toothbrushing ($p=0.050$) and self-examination ($p=0.018$). At one year period, the intervention I and control groups remained showing improvement in some knowledge items. The intervention I group had significantly higher knowledge scores for 3 items: duration of toothbrushing ($p<0.001$), type of toothpaste ($p=0.013$), and recommended drink ($p=0.034$). The control group had significantly higher knowledge scores for 3 items: type of toothpaste ($p=0.018$), benefit of using mouth rinse ($p=0.025$), and self-examination ($p=0.008$). Total knowledge scores were significantly higher for all comparisons.

Analyses on changed scores of each group were shown in Table 2. At 6th month and 1 year periods, almost all knowledge items of the three groups increased (plus symbol in Table). Through comparing changed scores between the intervention I and the control groups for 6th month and 1 year periods, as well as between intervention II and control group for 1 year period, significant differences were found for only intervention I group compared to baseline at 1 year period. Intervention I

group obtained significantly higher improvement than control groups for one knowledge items: duration of tooth brushing (changed scores of +0.4 for intervention I and +0.1 for control, $p=0.048$). On the other hand, the intervention I group had better knowledge on benefit of using mouth rinse ($p=0.045$). Total knowledge scores did not statistically significant differ for any comparison (Table 2).

Behaviors

At 6th month period, the intervention I and the control groups improved some behaviors (Table 3). The intervention I group obtained significantly higher scores, compared to baseline, for 4 behaviors items: frequency of tooth brushing ($p=0.014$), type of toothpaste ($p=0.008$), eating fruits ($p=0.014$) and recommended drinks ($p<0.001$). For the control group, 3 items significantly improved: frequency of tooth brushing ($p=0.014$), fluoride mouth rinse ($p=0.034$) and self-examination ($p=0.025$), while the item of examination by dentist, obtained a lower score ($p < 0.001$). At one year period, the

Table 3 Comparison of behavior scores at each time point with baseline within each study group using Wilcoxon Signed Ranks test

Behaviors	Control (Mean±SD) (n=56)			Intervention I (Mean±SD) (n=47)			Intervention II (Mean±SD) (n=20)	
	Baseline	6 months	1 year	Baseline	6 months	1 year	Baseline	1 year
Frequency of tooth brushing	0.9±0.3	1.0±0 p=0.014 ¹	0.9±0.3 p=0.157 ²	0.9±0.3	1.0±0 p=0.014 ¹	1.0±0.2 p=0.102 ²	0.7±0.5	0.9±0.3 p=0.046 ²
Duration of tooth brushing	0.7±0.5	0.6±0.5 p=0.593 ¹	0.7±0.5 p=0.513 ²	0.8±0.4	0.8±0.4 p=1.000 ¹	0.9±0.4 p=0.102 ²	0.8±0.4	0.7±0.5 p=0.317 ²
Type of toothpaste	0.9±0.3	0.9±0.3 p=0.257 ¹	1.0±0.2 p=0.059 ²	0.7±0.5	0.9±0.3 p=0.008 ¹	0.9±0.2 p=0.001 ²	0.8±0.4	0.9±0.3 p=0.157 ²
Using mouth rinse	0.3±0.5	0.4±0.5 p=0.166 ¹	0.4±0.5 p=0.225 ²	0.3±0.5	0.3±0.5 p=0.705 ¹	0.2±0.4 p=0.083 ²	0.2±0.4	0.3±0.4 p=0.655 ²
Using fluoride mouth rinse	0.3±0.5	0.4±0.5 p=0.034 ¹	0.4±0.5 p=0.058 ²	0.3±0.5	0.4±0.5 p=0.206 ¹	0.4±0.5 p=0.096 ²	0.2±0.4	0.3±0.5 p=0.414 ²
Frequency of meal	0.9±0.4	0.8±0.4 p=0.317 ¹	0.8±0.4 p=0.180 ²	0.8±0.4	0.8±0.4 p=0.414 ¹	0.9±0.3 p=0.480 ²	0.9±0.4	0.9±0.3 p=0.317 ²
Eating vegetable with meals	1.0±0	1.0±0 p=1.000 ¹	1.0±0 p=1.000 ²	1.0±0.2	1.0±0 p=0.157 ¹	1.0±0 p=0.157 ²	1.0±0	1.0±0 p=1.000 ²
Type of snacks	0.9±0.3	1.0±0.2 p=0.157 ¹	0.9±0.3 p=1.000 ²	0.8±0.4	0.9±0.3 p=0.157 ¹	0.9±0.3 p=0.096 ²	0.9±0.4	0.9±0.3 p=0.564 ²
Eating fruits habit	0.5±0.5	0.6±0.5 p=0.127 ¹	0.6±0.5 p=0.564 ²	0.4±0.5	0.7±0.5 p=0.014 ¹	0.6±0.5 p=0.029 ²	0.6±0.5	0.5±0.5 p=0.763 ²
Recommended drink	0.7±0.5	0.8±0.4 p=0.248 ¹	0.8±0.4 p=0.157 ²	0.6±0.5	0.9±0.3 p<0.001 ¹	0.9±0.3 p=0.001 ²	0.9±0.3	0.9±0.4 p=0.655 ²
Self-examination	0.7±0.5	0.8±0.4 p=0.025 ¹	0.8±0.4 p=0.018 ²	0.6±0.5	0.7±0.5 p=0.059 ¹	0.7±0.4 p=0.058 ²	0.4±0.5	0.8±0.4 p=0.011 ²
Examination by dentist	0.4±0.5	0.1±0.2 p<0.001 ¹	0.1±0.2 p<0.001 ²	0.1±0.3	0.1±0.3 p=0.705 ¹	0±0.2 p=0.180 ²	0.1±0.2	0±0 p=0.317 ²
Total score	8.0±1.4	8.4±1.3 p=0.012 ¹	10.9±3.3 p<0.001 ²	7.3±2.1	8.4±1.7 p<0.001 ¹	11.2±3.0 p<0.001 ²	7.3±2.2	10.2±2.8 p=0.001 ²

¹ p-value of the comparison between 6 months and baseline

² p-value of the comparison between 1 year and baseline

Table 4 Comparing changed behavioral scores at the 6th month and 1 year of the intervention I and the intervention II with control groups using Mann-Whitney U test

Behaviors	Control (Mean±SD)		Intervention I (Mean±SD)		Intervention II (Mean±SD)
	6 months (n=56)	1 year (n=56)	6 months (n=47)	1 year (n=47)	1 year (n=20)
Frequency of tooth brushing	+0.1±0.3	0±0.2	+0.1±0.3	+0.1±0.4	+0.2±0.4
			p=0.748	p=0.346	p=0.020
Duration of tooth brushing	0±0.5	+0.1±0.6	0±0.4	+0.1±0.4	-0.1±0.4
			p=0.672	p=0.830	p=0.303
Type of toothpaste	+0.1±0.4	+0.1±0.3	+0.2±0.5	+0.3±0.4	+0.1±0.3
			p=0.056	p=0.036	p=0.916
Using mouth rinse	+0.1±0.5	+0.1±0.5	0±0.4	-0.1±0.5	+0.1±0.5
			p=0.200	p=0.040	p=0.767
Using fluoride mouth rinse	+0.1±0.4	+0.1±0.4	+0.1±0.5	+0.1±0.4	+0.1±0.6
			p=0.825	p=1.000	p=1.000
Frequency of meal	0±0.1	-0.1±0.3	0±0.4	0±0.4	0.1±0.2
			p=0.611	p=0.175	p=0.158
Eating vegetable with meals	0±0	0±0	0±0.2	0±0.2	0±0
			p=0.121	p=0.121	p=1.000
Type of snacks	+0.1±0.4	0±0.5	0.1±0.4	+0.1±0.4	+0.1±0.4
			p=0.850	p=0.238	p=0.671
Eating fruits habit	+0.1±0.6	+0.1±0.7	+0.3±0.7	+0.2±0.6	-0.1±0.8
			p=0.262	p=0.319	p=0.581
Recommended drink	+0.1±0.5	+0.1±0.6	+0.3±0.5	+0.3±0.5	-0.1±0.5
			p=0.018	p=0.090	p=0.267
Self-examination	+0.2±0.6	+0.2±0.5	+0.1±0.4	+0.1±0.4	+0.4±0.6
			p=0.377	p=0.557	p=0.116
Examination by dentist	-0.3±0.5	-0.3±0.5	0±0.4	-0.1±0.3	-0.1±0.2
			p=0.002	p=0.005	p=0.028
Total score	+0.4±1.3	+2.9±3.4	+1.1±1.6	+3.9±2.9	+3.0±2.9
			p=0.034	p=0.113	p=0.887

Table 5 Comparison of oral hygiene overtimes within each group and percentage improvement between control and the intervention groups

	Control (56)		Intervention I (47)		Intervention II (20)	
	n	%	n	%	n	%
Good oral hygiene						
Baseline	49	87.5	32	68.1	9	45.0
6 months	47	83.9	37	78.7		
1 year	52	92.9	34	72.3	14	70.0
p-value ¹	p=0.727		p=0.125		-	
p-value ²	p<0.001		p=0.003		p=0.581	
Improvement at 6 months from baseline	36	64.3	30	63.8	-	-
p-value ³			p=0.641			
Improvement at 1 year from baseline	25	44.6	27	57.4	14	70.0
p-value ⁴			p=0.237		p=0.069	

¹comparison within each group between 6 months and baseline (McNemar test)

²comparison within each group between 1 year and baseline (McNemar test)

³comparison of improvement between intervention and control groups at 6 months period (Chi-square test)

⁴comparison of improvement between intervention and control groups at 1 year period (Chi-square test)

intervention I group, behavioral improvement remained for 3 items: type of toothpaste, eating fruits and recommended drinks. For the intervention

II group, significant improvement was found for 2 items: frequency of tooth brushing (p=0.046) and self-examination (p=0.011). The control group

showed improvement for self-examination ($p=0.018$). Total behavior scores significantly improved for all comparisons.

Changed behavioral scores of the three groups were shown in Table 4. At the 6th month period, comparing changed scores between the intervention I and the control groups, the intervention I group obtained significantly better improvement for 2 behaviors items: recommended drink ($p=0.004$) and examination by dentist ($p=0.002$). Total changed behavioral scores of the intervention I group also significantly higher than the control group ($p=0.034$) At one year periods, comparing changed scores between the intervention I and the control groups, the intervention I group remained showing better behaviors for some items (type of toothpaste ($p=0.036$) and examination by dentist ($p=0.005$)). In addition, change scores of daily use of mouth rinse also significantly differed between the intervention I and the control groups. The intervention II obtained significantly better behaviors than the control groups for 2 behavioral items: frequency of tooth brushing ($p=0.020$) and examination by dentist ($p=0.028$). However, changes in total behavior scores did not differ for any comparison.

Oral hygiene status

Analyses on percentage of workers with good oral hygiene and percentage of workers changing to good oral hygiene for each of three groups were shown in Table 5. At the 6th month, there was no difference as compared to baseline, for the control and the intervention I groups. However, at 1 year period, percentages of workers having good oral hygiene of the three groups increased. Significant differences were found for the control ($p < 0.001$) and the intervention I ($p < 0.003$) groups. Through comparing percentages of workers changing to good oral hygiene, no significant difference was found.

DISCUSSION

This study's one year workplace oral health promotion program could improve oral health knowledge and behaviors of factory workers. Knowledge that was improved covered all important oral health topics, namely, toothbrushing practice, sugar consumption and oral examination. The improvement was found for the intervention groups in more than half of knowledge items (7 out of 11 items): frequency of toothbrushing, duration of toothbrushing, type of toothpaste, using mouth rinse, eating vegetable, recommended drink, self-examination. For oral health behaviors, improvement

of the intervention groups also related to all important oral health topics. Seven out of 12 behavioral items were improved, that is, frequency of toothbrushing, type of toothpaste, using mouth rinse, eating fruit, recommended drink, self-examination, examination by dentist. Moreover, out of the seven improved items, five items were knowledge and behaviors in the same topics, that is, frequency of toothbrushing, type of toothpaste, using mouth rinse, recommended drink and self-examination. This clearly showed that the improvement in knowledge could contribute to behavioral improvement [19].

Knowledge and behavioral improvements were more extensive for the intervention I than the intervention II groups. The intervention I group showed improvements in 6 knowledge items and in 6 behavioral items, while the intervention II group showed improvement only for 2 knowledge items, and 3 behavioral items. Possible reasons for the relatively lower effectiveness of the intervention II than the intervention I group related to types of oral health promoting activities that occurred in workplaces. Educational posters, morning talks, stimulations by head leaders and restriction on snack time occurred in the intervention I group, whereas only poster was used in the intervention II group. Although the intervention II group participated for only 6 months while the intervention I group did so for one year, this study found that knowledge and behaviors of the intervention I group already improved at the 6th month. Thus, shorter period of 6 months might not be a reason for the lower effectiveness. Due to an ethical consideration, oral examination together with oral health consultations was provided for the three groups. This might be a reason for the improvements in several knowledge and behavioural items as well as total scores within the three groups, including the control group (Tables 1, 3). However, improvements of the control group were found for fewer items than in the intervention groups. Sizes of the improvements or changes of the control group were also significantly smaller than those of the intervention groups (Tables 2, 4). Comparisons of the changes between groups (Tables 2, 4) revealed significantly better improvements for the intervention groups than the control group for only some items. Thus, in addition to comparisons within each group after 6 months and 1 year, the comparisons of changes between groups would provide more understanding on the potential effect of the program.

Previous studies on health promotion program showed that longitudinal programs could successfully improve health related knowledge and behaviors of adults [8, 20-24]. However previous studies on oral health promotions aimed at improving knowledge and behaviors in few common aspects particularly, toothbrushing practice, use of fluoride, snack consumption and dental service utilizations. No previous study on oral health promotion in adults has ever reported knowledge and behavioral improvement in detailed aspects such as duration of tooth brushing, fruit and drink consumption, self-examination that were included in the present study.

Health educational approach has been a basis of oral health promotion program. Various educational methods were used by previous studies such as leaflet, poster, video, individual direct teaching, training and practice exercises [8, 20, 22, 23]. In contrast to previous studies, the present study did not focus on individual teaching and training methods. Instead, oral health educational message was given mainly through displayed posters as well as reminding health messages to workers, namely weekly morning talks and stimulating workers by head workers. These methods were comparable to a study in Pakistan on school based oral health education which could increase adolescents' knowledge through peer leaders [21]. Thus, combination of education-based approach together with community participation in terms of peer or head worker supports as used in this study could successfully improve knowledge and subsequent behaviors of workers. In addition to education-based and community participating methods, policy and environmental change was also taken into consideration of the present study. The intervention I group initiated their policy on sugar consumption. Regulation to reduce sweetened food was set up, that is reduction of snack break times. Thus, workers unavoidably reduced their sugary snack and drink consumptions, which in the long term, would have the positive effect on dental caries reduction [4, 6]. Unfortunately, this study evaluated only oral hygiene, not dental caries because one year period would be too short to detect significant changes in dental caries in permanent teeth [25, 26].

Regarding oral hygiene status of workers, although the intervention I group improved their oral hygiene at 1 year period compared to baseline, this positive finding was questionable because the same finding was also observed for the control group. The

inconclusive finding on the benefit of our program on oral hygiene improvement might be explained by modes of oral hygiene instruction. The present study applied health education on toothbrushing through posters and morning talks as well as peer supports while previous studies used individual instruction and training on toothbrushing skill [8-10]. This could be considered as a limitation of the present study that the public and social-oriented method could not well improve oral hygiene of workers. Another limitation of the present study was the small sample in the intervention II group. This study's weakness related to expected poor participation of factories and difference in baseline data among workers because oral health was strongly determined by socioeconomic background [27]. Thus, we intended to invite only small to medium sized factories. However, there was very limited number of small/medium factories that reached inclusion criteria as well as limited number of workers in those factories. As the consequence, we could not recruit sample as required for the intervention II group, thus, findings on comparisons between intervention II and control groups should be interpreted with cautions. The small sample also limited study's analyses. Further studies on a larger sample using more stringent statistics would be required to clarify some questionable findings.

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