Original Article

Effectiveness of an Oral Health Promotion Program for the Elderly in Khiri Mat District, Sukhothai Province: A Randomized Control Trial

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ABSTRACT

Objectives: Oral disease is one of the most common health problems among the elderly, which impacts the quality of life. Applying the Health Belief Model (HBM) in oral health promotion is expected to improve the effectiveness of prevention and promotion that restricts oral health problems. The aim of the present study was to determine the effectiveness of an oral health promotion program on oral health behavior and oral status among the elderly in Khiri Mat, Thailand.

Materials and Methods: A prospective randomized control trial was carried out among 162 elderly people for 6 months. They were interviewed to gather oral health behaviors and perception information, followed by an oral health examination. The experimental group received oral health education based on the HBM theory and tooth brushing practice in a small group of 4–5 persons, and then they were remotivated to support behavior change at 1 and 3 months. The control group received traditional oral health activity. All the elderly were followed up at 6 months. Data were analyzed using the *t*-test, Mann–Whitney test, Chi-square, and logistic regression.

Results: The elderly in the experimental group had significantly higher oral health perception, lower plaque scores, lower gingival inflammation, and lower clinical attachment loss than those in the control group ($P < 0.05$).

Conclusion: This oral health promotion program improved oral health perception, behavior, and oral health status of the elderly.

KEYWORDS: *Health belief model, oral health, oral health promotion program, the elderly*

INTRODUCTION

Thailand has become an aging society since 2005.[1] Oral health issues of the elderly need an increase in awareness and attention because oral disease is one of the common health problems among the elderly.[2] The results of the 7th National Oral Health Survey found that the elderly who were partially edentulous was 88.3%, while those elderly completely edentulous was 7.2%. Tooth loss increased linearly by age. The percentage of the elderly with at least 20 natural teeth in Thailand was 73.6% whereas it was 38.6% among the elderly in Khiri Mat. The elderly with at least four posterior occluded teeth was 43.3% and 25.4% for the country and Khiri Mat, respectively. Tooth loss among elderly results in lower chewing performance impairs the digestive system and lower intake of nutrients.[3,4]

This problem can lead to a lower quality of life among the elderly.[5-8] Appropriate prevention and promotion among the elderly should be implemented to restrict oral health problems and possibly increase their quality of life. For the time being, the National Oral Health Program for the population age over 60 years, which includes health education in combination with oral hygiene instruction, is conducted in all levels of health services regulated by the Ministry of Health. Although

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the program has been carried out for some years, the prevalence of gingivitis, periodontal disease, and tooth loss does not seem to have decrease. The current oral health education may not be effective enough to improve those with poor oral health behaviors. The Health Belief Model (HBM) is a framework of health promotion that is expected to promote clients' perceptions in health risk, disease severity, and benefits of behavior change. Therefore, applying the HBM in oral health promotion could lead the elderly to avoid consequent oral disease. It is believed that soon after the elderly have perceived susceptibility and severity of their oral health problem, a healthier behavior will occur. HBM is suitable for use in both short- and long-term oral health behavior changes. Therefore, the purpose of this study was to determine the effectiveness of the oral health promotion program on oral health behavior and oral health status among the elderly in Khiri Mat District, Sukhothai province, Thailand.

MATERIALS AND METHODS

STUDY DESIGN AND SUBJECTS

A prospective randomized control trial for 6 months was carried out among 162 elderly people living in Khiri Mat District, Sukhothai province, Thailand. An equation estimated sample size and power for two binomial proportion was used.[9,10]

$$n = \left[\frac{\left(z_{1-\frac{\alpha}{2}}\sqrt{\bar{p}\bar{q}\left(1+\frac{1}{r}\right)} \right) + \left(z_{1-\beta}\sqrt{p_1 q_1 + \frac{p_2 q_2}{r}} \right)}{p_1 - p_2} \right]^2$$

$\bar{p} = \dfrac{p_1 + p_2 r}{1+r}$, $\bar{q} = 1 - \bar{p}$, $r = \dfrac{n_1}{n_2}$ $q_1 = 1 - p_1$, $q_2 = 1 - p_2$,

$z_{1-\frac{\alpha}{2}} = 1.96$, $z_{1-\beta} = 0.84$

p_1 = Proportion of tooth loss in experimental group = 0.208, p_2 = Proportion of tooth loss in control group = 0.05, n_1 = Sample size of experimental group, and n_2 = Sample size of control group, r = 1.

The proportion of gingivitis, clinical attachment loss (CAL) and tooth loss with alpha error of 5% and statistical power of 80% were put into the calculations and found that sample size for a proportion of tooth loss giving the biggest number that is 70 patients per group. To compensate for dropouts, 15% more patients were added to be 81 patients per group, giving a total of 162 patients. Inclusion criteria were the elderly without disability and aged between 60 and 74 years who had at least 6 natural teeth. The elderly who had uncontrolled diabetes and hypertension, presence of mental disorder, had dangerous communicable diseases, and unwilled to participate in the

study were excluded from the study. Before starting the study, all patients received necessary dental treatments and were randomly allocated into two groups by picking a sealed opaque envelope, which an equal number of 81 experiment- and control-envelops [Figure 1]. This study was approved by the Research Ethics Committee of the Faculty of Dentistry, Prince of Songkla University (No. EC6007-19-P-LR). Informed consent was obtained from all participants.

QUESTIONNAIRE AND ORAL HEALTH EXAMINATION

The closed-ended questionnaire was developed with two main parts. The first part was to collect demographic data; the second part was a 3-point Likert scale to assess oral health perception based on the HBM theory, including perception in disease susceptibility, severity, benefits, barriers, and self-efficacy. The questionnaire passed a content validity test by three experts in public health. Later, it was trialed among 30 elderly people, any unclear or misunderstood items were revised. All patients were examined by two standardized dentists, giving a kappa intercalibration for plaque score and gingival score of 0.81 and 0.63, respectively. To avoid information bias, both examiners were blinded, they did not know whether patients were members of the experimental group or the control group. The dental examination was carried out using a mouth mirror and periodontal probe under artificial light. Indexes used in this study were the Modified Quigley Hein plaque index, gingival index, CAL, and tooth loss.

INTERVENTION PROCEDURES

Intervention in the experimental group was conducted by two dental nurses, who were trained to have the necessary standard knowledge and skills of oral hygiene care and able to motivate behavior change among the elderly based on the HBM theory. All of the elderly joined the oral health promotion activity in a small
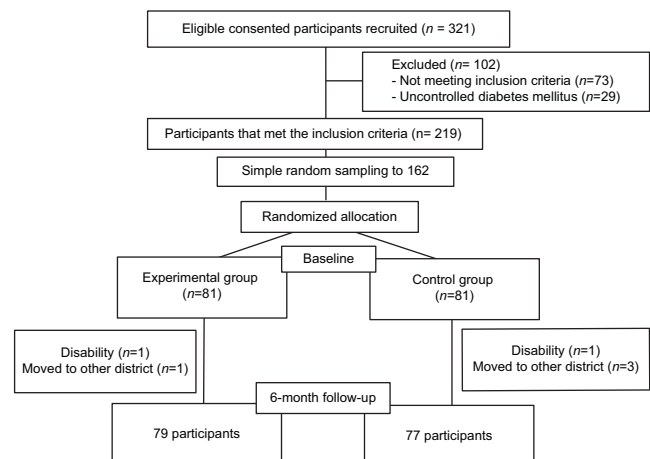

Figure 1: Sample and sample allocation

group of 4–5 persons. The programs took 30–35 min: first, the elderly's oral health status was returned, which was intended to lead the elderly to perceive their oral health risk, disease severity, and benefit of behavior changes, and then oral health-related knowledge was provided. Later, a toothbrush, fluoride toothpaste, and an oral care manual were delivered for practicing tooth brushing and denture cleaning. After 1 month, dental nurses made appointments with the elderly to join another session of oral health promotion activity in a small group of 4–5; this included 10–15 min of follow-up oral health behavior and a review of oral health-care skills and knowledge. After 3 months, the dental nurse made phone calls to ensure compliance and to review oral health-care skills and knowledge which took 5–10 min per patient.

Intervention in the control group – they received only regular oral health promotion, including oral health education, demonstrations on oral hygiene care, and denture cleaning, as well as receiving a toothbrush and fluoride toothpaste without practicing tooth brushing. After 6 months, both groups were interviewed and oral health examined to collect oral health perception data and oral health status by the same examiners using the same equipment and diagnostic criteria as those used at baseline.

STATISTICAL ANALYSIS

All data were cleaned and checked for completeness shortly. After finishing all data collection, then entered into a computer. Categorical data were presented in frequency and percentages; the Chi-squared test was used to compare gender, educational level, occupation, monthly income, and systemic disease. The numerical data were presented in means and standard deviations. The *t*-test was used to compare mean scores of plaque index, gingival index, and CAL between the experimental and control groups. The Mann–Whitney test was also used when appropriate. Logistic regression was used to describe the relationship between gender, age, educational level, occupation, monthly income, systemic disease, oral health perception, and oral health status. The cut points to make plaque score, gingival score, and CAL to be binary outcomes were 1, 3, and 3.5, respectively. The level of statistical significance was set at 0.05.

RESULTS

During the study, six patients were excluded, four moved out of the study area and two became disables, resulting in 79 remaining in the experimental group and 77 in the control group [Figure 1]. General characteristics of the experimental group did not differ from that of the

control group, with an average age of 65 years. More than half of the participants had finished primary school, were employed, had low income, and had systemic diseases [Table 1].

After the intervention, both experimental and control groups had higher oral health perception scores. The experimental group had a significantly better perception in oral disease susceptibility, severity, risk, benefits, and self-efficacy in prevention than that of the control group [$P < 0.05$, Table 2].

At baseline, there were no differences in plaque index score, gingival index score, CAL, or tooth loss between the groups. After 6 months, both groups had a lower plaque index score and CAL compared to that at baseline, whereas tooth loss was not significant as no patient has tooth loss during the study. When comparing between the groups, the experimental group had a statistically significant lower plaque index score, gingival index score, and CAL than that of the control group [Table 3].

Logistic regression analyses show that the level of plaque index score, gingival index score, and CAL were associated with brushing frequency, perceived susceptibility, and self-efficacy. The elderly who brushed their teeth once a day had eight times higher plaque score, six times higher gingival inflammation, and higher CAL compared to those who brushed their teeth twice a day [Table 4]. Furthermore, those who had lower self-efficacy were found to have three times, eight times, and three times higher plaque score, gingival

Table 1: Distribution of general characteristics

	Experimental group (*n*=79), *n* (%)	Control group (*n*=77), *n* (%)	*P*
Gender			
Male	45 (57.0)	32 (41.6)	0.054
Female	34 (43.0)	45 (58.4)	
Age mean±SD	65.16±4.23	65.73±4.18	0.376
Educational level			
Primary school	52 (65.8)	51 (66.2)	0.991
Secondary school	15 (19.0)	14 (18.2)	
Bachelor's degree or higher	12 (15.2)	12 (15.6)	
Occupation			
Unemployed	8 (10.1)	10 (13.0)	0.576
Employed	71. (89.9)	67 (87.0)	
Monthly income			
Abundant	6 (7.6)	5 (6.5)	0.812
Sufficient	23 (29.1)	26 (33.8)	
Deficient	50 (63.3)	46 (59.7)	
Systemic disease			
No	20 (25.3)	24 (31.2)	0.417
Yes	59 (74.7)	53 (68.8)	

SD=Standard deviation

Table 2: Comparisons of oral health perception among the experiment and control groups at baseline and after 6 months

	Experimental group (*n*=79), *n* (%)		Control group (*n*=77), *n* (%)		*P*
	Low	High	Low	High	
Perceived severity					
Baseline	44 (55.7)	35 (44.3)	36 (46.8)	41 (53.2)	0.169
After 6 months	7 (8.9)	72 (91.1)	25 (32.5)	52 (67.5)	<0.001
Perceived susceptibility					
Baseline	39 (49.4)	40 (50.6)	35 (45.5)	42 (54.5)	0.625
After 6 months	3 (3.8)	76 (96.2)	21 (27.3)	56 (72.7)	<0.001
Perceived benefits					
Baseline	34 (43.0)	45 (57.0)	32 (41.6)	45 (58.4)	0.852
After 6 months	5 (6.3)	74 (93.7)	30 (39.0)	47 (61.0)	<0.001
Perceived barriers					
Baseline	39 (49.4)	40 (50.6)	32 (41.6)	45 (58.4)	0.340
After 6 months	6 (7.6)	73 (92.4)	18 (23.4)	59 (76.6)	0.006
Self-efficacy					
Baseline	48 (60.8)	31 (39.2)	35 (45.5)	42 (54.5)	0.055
After 6 months	9 (11.4)	70 (88.6)	38 (49.4)	39 (50.6)	<0.001

Table 3: Comparisons of plaque index score, gingival index score, and clinical attachment loss

	Mean±SD		*P*
	Experimental group (*n*=79)	Control group (*n*=77)	
Plaque index score			
Baseline	3.28±1.03	3.11±0.90	0.267
After 6 months	2.69±0.56	2.98±0.71	<0.01
P	<0.01	<0.01	
Gingival index score			
Baseline	1.57±0.24	1.48±0.24	0.052
After 6 months	1.22±0.58	1.46±0.50	<0.01
P	<0.01	0.447	
Clinical attachment loss (mm.)			
Baseline	3.78±0.87	3.60±0.86	0.206
After 6 months	2.99±0.44	3.48±0.43	<0.01
P	<0.01	0.022	

SD=Standard deviation

inflammation, and CAL, respectively. The elderly with lower perceived susceptibility were found to have higher CAL. However, demographic factors and systemic diseases were not associated with the elderly's oral health status.

DISCUSSION

The oral health promotion program based on the HBM improved oral health perception in severity, susceptibility, benefits, barriers, self-efficacy, and improved tooth brushing frequency. Furthermore, the elderly in the experimental group also had better oral hygiene, reduced gingivitis, and CAL. The successful of the program provide an evidence that oral advice with demonstration tooth brushing is not enough to promote oral health behavior change. Instead, the oral health education provided by well-trained staff and oral health status reflection in a small group based

on the HBM of the present study allowed the elderly to think about and perceive their own oral health risk and disease severity. These results confirm the results of a previous study in Iran.[11] Meanwhile, the delivery of toothbrushes and toothpaste with tooth brushing and denture cleaning instruction rendered the elderly perceived self-efficacy and benefits of healthy behaviors. Practicing tooth brushing activities in experimental group motivated and empowered the elderly to brush more frequently resulting in better oral hygiene, better gingival status, and reducing the CAL. These results are consistent with previous findings in a review of the effectiveness of oral health activities among the elderly.[12]

The sample size was cautiously calculated to justify sufficient sample, whereas it was only a few dropouts, no selection bias, and blinding the observers to avoid information bias were the strengths of the study.

Table 4: Logistic regression analysis for general characteristics, tooth brushing and oral health perception on oral health status (*n*=156)

Variables	Adjusted OR (95% CI)		
	Plaque index score	Gingival index score	Clinical attachment loss
Gender			
Male	1.13 (0.50-2.58)	0.82 (0.36-1.84)	1.30 (0.56-3.02)
Female	1	1	1
Educational level			
Primary school	1.74 (0.50-6.01)	4.59 (0.42-14.84)	1.83 (0.52-6.44)
Secondary school	0.85 (0.18-4.08)	4.31 (0.04-17.88)	0.40 (0.07-2.34)
Bachelor's degree or higher	1	1	1
Occupation			
Unemployed	1.31 (0.40-4.24)	0.67 (0.21-2.09)	5.23 (0.64-16.66)
Employed	1	1	1
Systemic disease			
No	1	1	1
Yes	2.43 (0.90-6.58)	1.80 (0.71-4.55)	2.06 (0.74-5.72)
Tooth brushing frequency			
≤1 time/day	8.56 (2.52-29.14)**	6.06 (1.14-22.14)*	6.79 (2.06-22.41)**
≥2 time/day	1	1	1
Perceived severity			
Low	0.85 (0.29-2.52)	0.86 (0.28-2.64)	1.48 (0.51-4.32)
High	1	1	1
Perceived susceptibility			
Low	8.01 (2.32-27.66)**	10.66 (0.22-17.65)	6.43 (1.94-11.35)**
High	1	1	1
Perceived benefits			
Low	1.35 (0.46-4.02)	1.56 (0.46-5.31)	0.86 (0.27-2.77)
High	1	1	1
Perceived barriers			
Low	0.85 (0.27-2.66)	0.98 (0.29-3.42)	0.99 (0.31-3.12)
High	1	1	1
Self-efficacy			
Low	3.20 (1.29-7.91)*	8.58 (2.52-24.18)**	3.38 (1.32-8.66)*
High	1	1	1

Adjusted OR = Adjusted odds ratio for gender, educational level, occupation, systemic disease, tooth brushing frequency, perceived severity, perceived susceptibility, perceived benefits, perceived barriers and self-efficacy. CI = Confidence interval, *$P < 0.05$, **$P < 0.01$

However, it was unable to control the contamination of intervention between the experimental and control groups, simply because elderly people live close to each other and they could have had the opportunity to discuss the activities. Therefore, this could affect the effectiveness of the program.

The baseline oral health status of 156 elderly samples was consistent with that of the National Oral Health Survey[3] with plaque covering half of the teeth surfaces, generalized gingival swelling with redness, and some bleeding on probing and with the cervical third having attachment loss. After intervention for 6 months, all the elderly in the experimental group had a significantly lower plaque score and better gingival status and attachment loss. Although it was only a modest improvement, a constant improvement would result in significant effectiveness of the program in the long term.

The improvement of gingival health and lower CAL indicated that prevention and promotion of the program are effective to control periodontal disease, which is claimed as an ultimate health outcome.[12]

In this study, dental nurses described the risk of the oral disease by reflecting the oral status of the elderly and by staining teeth with 5% erythrosine to initiate awareness. At the same time, dental nurses demonstrated brushing on the dental model, then coached the elderly to brush their teeth until their teeth were clean. The elderly with higher self-efficacy in brushing had less plaque. The results of the present study are consistent with previous studies showed that a lower plaque score was associated with higher self-efficacy and better oral health behavior.[12-14] The possible explanation is that higher tooth brushing frequency was associated with higher self-efficacy.[13] A systematic review of

Manoranjitha *et al*.[14] found that most of the oral health education theories and approaches are showing positive effects on oral health status, whereas only a couple of articles found negative effects. Changing perceptions with follow-up motivating session affected the elderly to be familiar with the dental nurses and have confidence to communicate with them. The results confirm the evidence from previous studies indicated that good communication in oral health promotion with follow-up motivation had influenced the elderly to have better compliance. Empowerment made the elderly to be more confident in their potential for oral health care.[15-17] Furthermore, the elderly who considered that regular tooth brushing can reduce the risk of oral disease appeared to brush more before bedtime each day.[18]

In the experimental group, the plaque index score and gingival index score decreased after 6 months and were lower than that of the control group, reflecting that the experimental group had a better brushing skill. It is consistent with previous study where the changing perception of oral health made patients take more oral care.[19] Moreover, higher oral hygiene-related self-efficacy was associated with better gingival status. The elderly who were confident that they could brush their teeth better would intentionally clean their teeth until the gingival inflammation was reduced.[20] Dental treatments and oral health promotion programs including scaling, root planing, and oral hygiene instructions resulted in better oral health behavior and attachment levels.[21]

Future studies should focus on the long-term effects of this oral health promotion program on the elderly's oral health status and behaviors, as most of the studies have a duration of study <2 years.[22-24] Furthermore, evidence from this study suggests that health workers should be trained, both informal and formal,[25,26] to apply appropriate oral health promotion including continuing re-enforcement. To confirm the success of the program as recommended by the WHO,[27] extensive community engagement to enhance ownership of the program is needed, whereas the Ministry of Health should have policy and funding to support the promotion program among local health service organizations.

Conclusion

This oral health promotion program based on the HBM improved oral health perception and behavior of the elderly, leading to better oral health status, namely their plaque index score, gingival index score, and CAL.

Conflicts of interest

There are no conflicts of interest.

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