

Original article

Associations of the number of remaining natural teeth and oral health behaviors with subjective chewing problems based on the Thailand National Oral Health Survey 2017

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Abstract

Purpose: Few studies have examined the association of oral health behaviors with chewing ability. This study aimed to investigate the associations between the number of remaining natural teeth and oral health behaviors with subjective chewing ability among older Thai adults.

Methods: Analysis was carried out using data from the 8th Thailand National Oral Health Survey. Subjective chewing problems were assessed using self-reported questionnaires, and the number of remaining teeth by oral examination. Poisson regression with sampling weights was used to calculate the prevalence ratios (PRs) and 95% confidence intervals (CIs) for having chewing problems.

Results: Of the 2,310 participants (mean age, 67.2 ± 4.5 years), 53.3% had chewing problems. After adjusting for all covariates, significantly higher PRs for having chewing problems were observed among the participants without interdental cleaning (PR, 1.32; 95% CI, 1.06-1.65), without nighttime brushing (PR, 1.12; 95% CI, 1.01-1.25), who were edentulous (PR, 1.16; 95% CI, 1.02-1.31), had urgent dental treatment within the past 12 months (PR, 1.15; 95% CI, 1.06-1.24), and who brushed for <2 min (PR, 1.10; 95% CI, 1.02-1.20).

Conclusion: The number of remaining natural teeth and oral health behaviors were significantly associated with subjective chewing problems.

Keywords: chewing problems, national oral health survey, number of remaining natural teeth, oral health behaviors

Introduction

Chewing problems affect food choices and compromise nutritional intake [1,2]. Low nutrient intake is associated with low muscle strength, decreased physical function, and disability in activities of daily living [3]. Tooth loss is a major cause of impaired masticatory function [4,5]. A previous study reported that chewing ability may decrease due to an inadequate number of teeth and oral pain, both of which are important determinants of chewing disability [6]. Oral health behavior can also affect chewing ability because poor oral health behavior increases the risk of tooth loss. A previous study demonstrated that people who had never used dental floss and had irregular dental check-ups had fewer remaining teeth than those who flossed at least once a day and had frequent dental check-ups [7].

In addition to tooth loss, several factors lead to chewing problems, including impaired masticatory function, caries, periodontal disease, dry mouth, and problems with denture wear. Some of these factors can affect oral health behavior. However, few studies have examined the association between the number of remaining natural teeth and oral health behaviors with subjective chewing problems.

The Thailand National Oral Health Survey (TNOHS) is a nationally representative oral health survey in Thailand that has been conducted by the Bureau of Dental Health (Department of Health, Ministry of Public

Health, Thailand) since 1977. The survey recently reported an increased incidence of tooth loss. Therefore, the number of people experiencing chewing problems is expected to increase. This study aimed to investigate the associations of the number of remaining natural teeth and oral health behaviors with subjective chewing problems among the independent older population in Thailand.

Materials and Methods

Setting and participants

This research was approved by the Ethical Committee of the Department of Health, Ministry of Public Health, Thailand (approval date, September 19, 2019, No. 353; continuous approval date, September 10, 2020, RF 13-01-353), and by Tokyo Medical and Dental University (approval no. D2019-057). The study was also conducted in accordance with the Declaration of Helsinki of the World Medical Association. The present cross-sectional study used secondary data from the 8th TNOHS. This survey applied a stratified three-stage sampling technique to represent the whole population in Thailand. Following the oral health survey methods of the World Health Organization (WHO), the TNOHS targeted separate age groups. These included preschool children (aged 3-5 years), children and youth (aged 12-15 years), middle-aged adults (aged 35-44 years), older adults (aged 60-74 years), and late older adults (aged 80-85 years) from 24 provinces in 12 health regions and from metropolitan Bangkok. Finally, 26,259 individuals (49.4% male and 50.6% female) participated in this survey in all indexed age groups. During the survey, 19 dental examiners were trained using the WHO protocol (WHO, Oral health surveys: basic methods. 5th ed; 2013). The Kappa score for caries was 0.78-0.87, which indicated a substantial agreement level; and that for the periodontal status was 0.46-0.78, which indicated moderate agreement. The questionnaire used in the survey was created and approved after a pilot study, following which it was reevaluated by the Bureau of Dental Health experts based on WHO guidelines. The dentists conducted clinical oral examinations after obtaining consent from the participants; all procedures were carried out with the adequate understanding and written consent of the subjects. The total number of participants aged 60-74 years was 4,134 after excluding physically dependent older people ($n = 167$) and participants with any missing data ($n = 1,657$) from the questionnaire and clinical oral examination. Thus, 2,310 participants (1,150 male and 1,160 female) were included in this study.

Dependent variables, independent variables, and covariates

When assessing chewing problems in a large-scale national survey, subjective measures are useful because they are convenient and inexpensive [8,9]. Therefore, the presence of subjective chewing problems was determined based on the responses to the question "Do you have chewing problems?" Responses were categorized as "no" for those who answered "no chewing problems" and "yes" for those who answered either "sometimes, but I can chew" or "yes, I have severe chewing problems."

The number of remaining natural teeth was determined by an oral examination, which was conducted based on the WHO guidelines. When calculating the number of remaining teeth in this analysis, third molars were excluded. The remaining teeth were categorized into four groups: (1) ≥20 teeth, (2) 11-19 teeth, (3) 1-10 teeth, and (4) edentulous. To assess oral health behavior, the following questions were used: "Do you brush

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Table 1 Prevalence of chewing problems according to sociodemographic and oral characteristics

Characteristic	Categories	Total (%) <i>n</i> = 2,310	No chewing problems <i>n</i> = 1,078	Have chewing problems <i>n</i> = 1,232
Age	60-67 years	1,234 (53.4)	48.0	52.0
	68-74 years	1,076 (46.6)	45.2	54.8
Sex	male	1,150 (49.8)	46.4	53.6
	female	1,160 (50.2)	46.9	53.1
Residential location	urban	1,279 (55.4)	46.1	53.9
	rural	1,031 (44.6)	47.4	52.6
Marital status	S/W/D	707 (30.6)	47.5	52.5
	married	1,603 (69.4)	46.3	53.7
Education	low (≤ 6 years)	1,756 (76.0)	45.1	54.9
	high (> 6 years)	554 (24.0)	51.6	48.4
Income	low (≤ 160.02 USD/month)	1,528 (66.1)	44.4	55.6
	high (> 160.02 USD/month)	782 (33.9)	51.2	48.8
Number of remaining natural teeth	≥ 20 teeth	978 (42.3)	49.7	50.3
	11-19 teeth	587 (25.4)	46.7	53.3
	1-10 teeth	490 (21.2)	44.1	55.9
	edentulous	255 (11.0)	40.0	60.0
Do you brush your teeth in the morning?	usually/sometimes	2,252 (97.5)	46.8	53.2
	no	58 (2.5)	43.1	56.9
Do you brush your teeth before going to bed?	usually/sometimes	2,051 (88.8)	47.8	52.2
	no	259 (11.2)	37.8	62.2
Do you brush your teeth for 2 min?	≥ 2 min	1,708 (73.9)	48.4	51.6
	< 2 min or uncertain	602 (26.1)	41.9	58.1
Do you use dental floss or an interdental brush?	yes	139 (6.0)	61.2	38.8
	no	2,171 (94.0)	45.7	54.3
Have you had any urgent dental treatment in the last year?	yes	932 (40.3)	42.5	57.5
	no/forgot	1,378 (59.7)	49.5	50.5

S/W/D, single/widowed/divorced

your teeth in the morning?” (“usually,” “sometimes,” or “no”) and “Do you brush your teeth before going to bed?” (“usually,” “sometimes,” or “no”). Responses of “usually” or “sometimes” were categorized together, while responses of “no” were categorized separately. Participants were also asked, “Do you brush your teeth for 2 min or less?” (“ ≥ 2 min,” “ < 2 min,” or “Uncertain”). Responses to this question were categorized into two groups: (1) ≥ 2 min more and (2) < 2 min or uncertain. Responses to “Do you use dental floss or interdental brushes?” were categorized as “yes” or “no.” Responses to “Did you have any urgent dental treatment last year?” (“yes,” “no,” or “forgot”) were categorized as either “yes” or “no/forgot.”

Covariates included age, sex (“male” or “female”), residential location (“urban” or “rural”), marital status (“single/widowed/divorced” or “married”), educational attainment (“low” [≤ 6 years, no education, or elementary school] or “high” [> 6 years; junior high school, or more]), and income (“low” [no income to $\leq 5,000$ baht/month; 160.02 USD/month] or “high” [$> 5,000$ baht/month; 160.02 USD/month]; 1 USD = 31.25 baht).

Statistical analysis

Descriptive analysis was performed to describe the characteristics of samples and classify them according to the chewing problems. This study applied Poisson regression with robust variance and sampling weights to calculate prevalence ratios (PRs) and 95% confidence intervals (CIs). This study did not use logistic regression and odds ratios because the prevalence of chewing problems was not rare; therefore, the odds ratios would have overestimated the associations in this study [10-13]. To assess the independent associations of oral-related independent variables and the possibility of collinearity or overadjustment, separate models were built. First, crude PRs were estimated for each oral-related independent variable using a univariate model, and then covariates (age, sex, residential location, marital status, educational attainment, and income) were adjusted for each variable related to oral health behavior. Finally, all oral-related independent variables and covariates were included in the model. All data analyses were conducted using STATA 15.0.

Results

The mean age of the participants was 67.2 ± 4.5 years, and 53.3% had chewing problems. Table 1 presents the distribution of chewing problems among the participants. Participants who had low educational attainment and income levels had a higher prevalence of chewing problems. More-

over, edentulous older people, participants who did not brush their teeth before going to bed, participants with a brushing time of < 2 min, those who did not use interdental cleaning products, and participants with dental care utilization last year for urgent treatment had a higher prevalence of chewing problems.

The fully adjusted models confirmed that PRs for chewing problems were substantially higher among edentulous older adults (PRs, 1.16; 95% CI, 1.02-1.31), participants who went to bed without brushing (PRs, 1.12; 95% CI, 1.01-1.25), those who brushed for < 2 min (PRs, 1.10; 95% CI, 1.02-1.20), those who did not perform interdental brushing (PRs, 1.32; 95% CI, 1.06-1.65), and those who had urgent dental treatment within the past 12 months (PRs, 1.15; 95% CI, 1.06-1.24) (Table 2).

Discussion

This study is the first attempt in Thailand to investigate the association between the number of remaining natural teeth and oral health behaviors with subjective chewing problems among the independent older population. Not only the number of remaining teeth, but also oral health behaviors were significantly associated with subjective chewing problems. This study found a significantly higher prevalence of subjective chewing problems among older people with ≤ 10 teeth and edentulous individuals, and among those with ineffective brushing behaviors and those who had urgent dental treatment within the past 12 months.

The present findings indicated that older edentulous adults were 1.2 times more likely to encounter chewing problems than dentate individuals. According to a previous study in Taiwan, older people experienced difficulties in chewing hard food when they had fewer than eight occluding pairs of teeth [7]. Another study in Thailand concluded that individuals with fewer than 20 remaining teeth have greater difficulty speaking, swallowing, and chewing [14]. As such, chewing problems have been reported from a study to occur more frequently among individuals with a decreased number of posterior functional tooth units (FTUs) or tooth-bound spaces [4]. A study in Japan reported that the participants with a higher mean number of natural teeth or FTU had better chewing ability measured by Yamamoto’s chewing ability test [15]. Moreover, another study in Australia reported that chewing ability might decrease as a result of inadequate tooth number and pain in the mouth, which are important determinants of chewing disability [6].

This practical evidence highlights effective toothbrushing and regular

Table 2 Associations of the number of remaining natural teeth and oral health behaviors with chewing problems assessed using Poisson regression among individuals aged 60-74 years

Variable	Categories	Univariate PR	95% CI	Covariate PR*	95% CI	Fully adjusted PR**	95% CI	
Number of remaining natural teeth	≥20 teeth	reference		reference		reference		
	11-19 teeth	1.05	0.95-1.17	1.05	0.95-1.16	1.05	0.95-1.16	
	1-10 teeth	1.14	1.03-1.26	1.13	1.02-1.25	1.12	1.01-1.23	
	edentulous	1.20	1.06-1.35	1.17	1.04-1.33	1.16	1.02-1.31	
Oral health behavior								
	Do you brush your teeth in the morning?	usually/sometimes	reference		reference		reference	
		no	1.07	0.85-1.35	1.09	0.87-1.38	1.07	0.85-1.35
	Do you brush your teeth before going to bed?	usually/sometimes	reference		reference		reference	
		no	1.17	1.05-1.31	1.13	1.02-1.26	1.12	1.01-1.25
	Do you brush your teeth for 2 min?	≥2 min	reference		reference		reference	
		<2 min or uncertain	1.13	1.03-1.22	1.11	1.03-1.21	1.10	1.02-1.20
	Do you use dental floss or an interdental brush?	yes	reference		reference		reference	
		no	1.39	1.12-1.73	1.31	1.05-1.64	1.32	1.06-1.65
	Have you had any urgent dental treatment in the last year?	no/forgot	reference		reference		reference	
		yes	1.13	1.04-1.22	1.14	1.06-1.23	1.15	1.06-1.24

*One oral-related independent variable was adjusted for age, sex, residential location, marital status, educational attainment, and income. **All variables and covariates were included in the model. CI, confidence interval; PR, prevalence ratio

dental visits to maintain chewing ability. Toothbrushing is the cornerstone of oral hygiene and serves as a useful and highly cost-effective method of reducing biofilm, which is the main etiologic agent involved in the pathogenesis of oral disease. Periodontal disease causes discomfort or pain in the mouth [16], and toothache due to dental caries can also cause chewing problems [17,18]. Previous studies have suggested that adequate brushing and regular dental visits can reduce dental caries [17,19] and periodontal disease [18,20,21]. It is generally recommended to brush teeth with a fluoridated dentifrice at least twice a day for 2 min and clean the interproximal area with floss or interdental brushes to promote daily oral hygiene and reduce oral disease [22-24]. Effective toothbrushing may help to preserve natural teeth, thereby helping to maintain chewing ability [25].

In this study, dental care utilization affected the risk of subjective chewing problems. Most participants who had urgent dental treatment within the past 12 months such as toothache, hypersensitivity, or discomfort had a higher risk of chewing problems after adjusting for covariates. This result supports the findings of a previous study, which noted that routine dental check-ups, rather than symptom-driven dental utilization, should be encouraged to reduce tooth loss [26]. A systematic review reporting the association between the frequency of dental check-ups and oral disease noted a significant increase in caries and periodontal disease with a decrease in routine dental checks. According to 8th TNOHS, 42% of adults visited a dental clinic for treatment in the last 12 months, while among older people, it was a slightly lower percentage, 39%. However, only 22% of older participants and 16% of adults reported dental visits for regular check-ups. These frequencies of dental visits were lower than in Japan, a country with the highest access to dental care in OECD (Organization for Economic Cooperation and Development) countries [27]. A study in Japan reported 40.3% of the participants attended treatment, and 28% received preventive dental care including check-ups in the last 12 months [28]. However, further research is required to examine the relative effectiveness of routine dental checks performed at different frequencies in terms of oral health outcomes [29]. Additionally, a review of regression analyses revealed that the barriers leading to delayed dental care utilization by more than a year included socioeconomic status, health service deficits, and health or oral health variables [30,31].

The most prominent advantage of this study was the large number of independent older participants whose oral health status and behaviors were investigated. Although self-assessed masticatory ability is valuable and suitable for large epidemiological surveys, there were several limitations to this study. First, a self-reported questionnaire regarding chewing ability is not a validated, accurate measure of masticatory performance, although a similar questionnaire has been validated in previous studies [8,9]. Second, the study participants were older adults ranging in age from 60 to 74 years; thus, there is a limited ability to generalize the finding to all Thai populations. Finally, this was a cross-sectional study that failed to establish temporal associations, necessitating future longitudinal studies.

In conclusion, the present study demonstrated that the number of remaining natural teeth, and oral health behaviors were significantly associated with subjective chewing problems. Therefore, public health policies

that promote effective toothbrushing and regular check-up visits to attenuate tooth loss are critical for helping older adults maintain chewing ability. In addition to such national strategies, further studies involving objective assessments of masticatory ability are required given that self-reported measures may not reflect the actual extent of chewing problems.

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Conflict of interest

The authors declare no conflicts of interest.

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