Oral Health Status and Physical Frailty in Community-dwelling Older Adults

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Abstract

The evidence of relationship between oral health status and frailty is limitedly available. The aim of this study was to examine the association between oral health status and physical frailty.

Two hundred and ninety seven community-dwelling adults aged 60 and older were invited to this cross-sectional study. Frailty was defined on the basis of five components; unintentional weight loss, exhaustion, low level of physical activity, slow walking speed, and low grip strength. Participants with three or more components were classified as frail, with one or two as pre-frail, and with zero as non-frail. Oral health measures were number of teeth, posterior occluding pairs, xerostomia and dysphagia. Baseline characteristics included socio-demographic and health variables.

The association between oral health status and frailty were carried out with binary logistic regression analysis. The prevalence rates of frailty and pre-frailty were 12.1% and 49.2% respectively. The fewer posterior occluding pairs were significantly associated with frailty and pre-frailty among community-dwelling older adults, independent of socio-demographic and general health status.

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Introduction

Frailty is a geriatric condition that defined as a state of increased vulnerability to external stressors as a result of reduced homeostatic reserve across numerous physiological systems.[1] With aging, malnutrition, insufficient exercise, unhealthy environment, injuries, illnesses and drugs accumulate, which is the beginning of the frailty cycle. These interrelated variables result in chronic under-nutrition, causing loss of bone and skeletal muscle mass, regular physical activity decreases, and down-regulation of physiological systems. These changes result in a significant decrease in resting metabolism and a reduction in total energy expenditure.[2] Frailty is a dynamic process that changes throughout time from one state to another.[2,3] A phenotype of frailty was identified by the presence of three or more of the following criteria, unintentional weight loss 5% or more of body weight in prior year, exhaustion, low level of physical activity, slow walking speed, and low grip strength,[4] that increase the risk of adverse health outcomes, including falls, hospitalization, disability, and mortality. A pre-frail state, the presence of one or two criteria, identified a subset at high risk of progressing to frailty.[2,3,5]

The prevalence of frailty, identified by Fried scale in community-dwelling adults age 65 years and older, representative of the national population, was found to vary from 4.9% to 27.3%.[6]

The factors associated with high prevalence of frailty consist of aging, female gender, low level of education and income,[4,7-10] cognitive impairment and depressive symptoms,[10-12] high number of medication used daily,[13,14] chronic diseases and comorbidities especially cardiovascular disease,[10,15] low and very high body mass index,[16] smoking,[17,18] and malnutrition.[19-23]

Furthermore, poor oral health status related to frailty such as few remaining teeth or complete edentulism,[24-26] impaired masticatory function,[27-31] xerostomia,[26] dysphagia,[32] and self-reported oral pain.[31] These problems may lead to food selection and unbalanced diet, increase risk

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of malnutrition,[33] and finally get into frailty cycle. It has been reported that loss of natural teeth occlusion and dysphagia were the risk factors for malnutrition among community-dwelling frail older adults.[34, 35] However, limited evidence is available about the relationship between oral health status and frailty[36] because the prevalence of frailty[6, 37] and oral health status[38, 39] vary according to racial and regional differences. To date, only one study has examined the association of oral health (chewing ability) and frailty in Thailand.[29] Further studies are required to identify the factors associated with frailty. Consequently, the aim of this study was to examine the association between oral health status and physical frailty.

Materials and methods

This cross-sectional study population consisted of 12,537 Thai men and women aged 60 and older who lived in the community of Mae Sai district, Chiang Rai province, Thailand, in November 2019. Sample size was calculated with Krejcie and Morgan formula at the level of confidence 95% and the prevalence of frailty at 22.7%[29] (n = 264). To prevent inaccuracies and incompleteness of the data, an additional 10% was added to the sample size. So the total sample was approximately 300 individuals. The participants were selected from the areas which were easily accessible and have a wide range of socioeconomic strata in proportion to the population. Then systematic random sampling was performed. Individuals with cognitive impairment, assessed with RUDAS-Thai version (Rowland Universal Dementia Assessment Scale) scores ≤ 19,[40, 41] or incomplete data collection were excluded.

All data of this study were collected during 2019 to 2020 by interviewed with structured questionnaire and clinical examination at the center of community such as multipurpose buildings, temples or community health center. The study interventions were carried out by calibrated dental examiner and trained interviewers. The study protocol was approved by the Ethical Committee of the Faculty of Dentistry Human Experimentation, Chiang Mai University (No.71/2019). Written informed consent was obtained from all the study participants.

Assessment of Frailty was based on the frailty criterion proposed by Fried *et al.*[4] The five components of frailty were measured as follows.

Weight loss: self-reported unintentional weight loss of 4.5 kg or more in the last 12 months.

Exhaustion: self-reported of at least 3 days of time feeling exhausted in the previous week, as identified by two questions "How often in the last week did you feel that everything you did was an effort?" and "How often in the last week did you feel you could not get going?".

Low level of physical activities: an answer of "no" to the questions "Do you engage in physical exercise or sports?" and "Do you do the housework on a regular basis?"

Slowness: stratified by gender and height, cut-off for time to walk 15 feet criterion for frailty.

Height ≤ 173 cm for men and height ≤ 159 cm for women, walk time ≥ 7 seconds

Height > 173 cm for men and height > 159 cm for women, walk time ≥ 6 seconds

Weakness: stratified by gender and BMI quartiles, cut-off for grip strength criterion for frailty.

BMI ≤ 24 and grip strength ≤ 29 Kg for men

BMI 24.1 – 26 and grip strength ≤ 30 Kg for men

BMI 26.1 – 28 and grip strength ≤ 30 Kg for men

BMI > 28 and grip strength ≤ 32 Kg for men

BMI ≤ 23 and grip strength ≤ 17 Kg for women

BMI 23.1 – 26 and grip strength ≤ 17.3 Kg for women

BMI 26.1 – 29 and grip strength ≤ 18 Kg for women

BMI > 29 and grip strength ≤ 21 Kg for women.

Participants with three or more components were considered frail, and those with one or two components were considered pre-frail. Participants without all components were considered non-frail.[4]

Oral health status included as follows.

Number of teeth was defined as the number of functional natural teeth present in the mouth.

Posterior occluding pairs (POPs) were defined as the number of pairs of premolar and molar teeth occluding with each other, except third molar. Both permanent teeth and artificial teeth were included.

Xerostomia was identified by four questions that related to salivary flow rate.[42] An

answer of "yes" to the questions

"Do you sip liquids to aid in swallowing dry foods?"

"Does your mouth feel dry when eating a meal?"

"Do you have difficulties swallowing any foods?"

"Does the amount of saliva in your mouth seem to be too little?"

Dysphagia was measured by 10-item Eating Assessment Tool (EAT-10), each item contains 0 – 4 scores; 0 = no problem and 4 = severe problem. The score of 3 or greater is abnormal.[43]

Baseline Characteristics included socio-demographic and health variables: age, gender, education (highest level), household income above the poverty line of Thailand in 2017 (2,686 baht/month) or not, body mass index (BMI), underlying diseases and comorbidities, number of medications used per day and smoking status (current smoker, former smoker or never smoked). Depressive symptoms were assessed using the Thai Geriatric Depression Scale (TGDS) includes 30 items: 0 – 12 scores for normal, 13 – 15 scores for mild depression, 16 – 20 scores for moderate depression and 21 – 30 scores for severe depression.[44] Nutritional status was evaluated using the Mini Nutritional Assessment (MNA®) includes 18 items: ≥ 24 scores for well-nourished, 17 – 23.5 scores for at risk of malnutrition and < 17 scores for malnourished.[45]

Statistical analysis involved descriptive and inferential analyses, with a 5% significance level and 95% confidence interval (CI). Variables were described using frequencies or arithmetic means and standard deviations (SD) when appropriate. All variables were categorized into dichotomous variable. The binary logistic regression model was used, employing oral health status as independent variables, frailty status as dependent variable and baseline characteristics as covariables.

Results

The final sample comprised 297 individuals who submitted complete data sets. The prevalent rates of frail, pre-frail and non-frail were 12.1% (n = 36), 49.2% (n = 146) and 38.7% (n = 115), respectively. Participants had an age range of 60 – 97 years and a mean age of 70.8 (SD ± 8.05) years, 67.3% (n = 200) were women, 68% (n = 202) had finished primary school, and 79.8% (n = 237) had a household income of more than 2,686 baht per month. Most of them were overweight (32.7%, n = 97), had hypertension (56.9%, n = 169), used 1 – 3 medications (76.1%, n = 226), never smoked (56.2%, n = 167), were not depressed (90.2%, n = 268) and well-nourished (87.5%, n = 260). Participants were edentulous 11.5% (n = 34), had 28 functional teeth 6.4% (n = 19), missing all POPs 21.6% (n = 64), had 8 POPs 14.8% (n = 44), had initial dysphagia 7.4% (n = 22), and xerostomia 8.8% (n = 26).

The bivariate analysis revealed that age, education level, number of medications used per day, smoking status, depression, nutritional status, number of teeth and POPs were significantly associated with frailty and pre-frailty. (Table 1)

characteristics	Non-frail (n = 115)	Pre-frail/Frail (n = 182)	OR (95% CI)	p-Value
Age (years)				
60 – 69*	82 (52.2%)	75 (47.8%)	3.55	< 0.001
≥ 70	33 (23.6%)	107 (76.4%)	(2.15 – 5.85)	
Gender				
Male*	30 (30.9%)	67 (69.1%)	0.61	0.060
Female	85 (42.5%)	115 (57.5%)	(0.36 – 1.01)	
Education level				
Primary school & higher*	96 (43.4%)	125 (56.6%)	2.30	0.005
No school	19 (25.0%)	57 (75.0%)	(1.30 – 4.13)	
Household income				
< 2,686 baht/month*	25 (41.7%)	35 (58.3%)	1.17	0.600
≥ 2,686 baht/month	90 (38.0%)	147 (62.0%)	(0.66 – 2.08)	
BMI				
≥ 23*	82 (42.3%)	112 (57.7%)	1.55	0.090
< 23	33 (32.0%)	70 (68.0%)	(0.94 – 2.57)	
Number of comorbidities				
None*	47 (44.8%)	58 (55.2%)	1.48	0.120
≥ 1	68 (35.4%)	124 (64.6%)	(0.90 – 2.40)	
Medications used per day				
0 – 3*	98 (43.4%)	128 (56.6%)	2.43	0.004
≥ 4	17 (23.9%)	54 (76.1%)	(1.33 – 4.46)	
Smoking status				
Never smoked*	73 (43.7%)	94 (56.3%)	1.63	0.046
Former/current smoker	42 (32.3%)	88 (67.7%)	(1.01 – 2.63)	
TGDS				
Normal (0 – 12 scores)*	109 (40.7%)	159 (59.3%)	2.63	0.042
Depression (13 – 30 scores)	6 (20.7%)	23 (79.3%)	(1.04 – 6.67)	
MNA				
Well-nourished*	109 (41.9%)	151 (58.1%)	3.73	0.005
At risk of malnutrition	6 (16.2%)	31 (83.8%)	(1.50 – 9.25)	
Number of teeth				
≥ 20*	69 (48.6%)	73 (51.4%)	2.24	0.001
0 - 19	46 (29.7%)	109 (70.3%)	(1.39 – 3.61)	
POPs				
4 – 8*	71 (48.0%)	77 (52.0%)	2.2	0.001
0 – 3	44 (29.5%)	105 (70.5%)	(1.37 – 3.55)	
Dysphagia				
No*	105 (38.2%)	170 (61.8%)	0.74	0.500
Yes	10 (45.5%)	12 (54.5%)	(0.31 – 1.78)	
Xerostomia				
No*	105 (38.7%)	166 (61.3%)	1.00	0.980
Yes	10 (38.5%)	16 (61.5%)	(0.44 – 2.30)	

Table 1. Descriptive and bivariate analysis of frailty status according to oral health and baseline characteristics. *reference.

After adjustment for baseline characteristic, age (OR = 3.07, 95% CI 1.78 – 5.29) and POPs (OR = 1.72, 95% CI 1.01 – 2.90) were significantly associated with pre-frailty and frailty. (Table 2)

	Adjusted OR (95% CI)	p-value
Age (≥ 70 years)	3.07 (1.78 – 5.29)	<0.001
Education level (no school)	1.35 (0.68 – 2.66)	0.393
Medications used per day (≥ 4)	1.94 (0.96 – 3.89)	0.063
Smoking status (former/current smoker)	0.99 (0.53 – 1.84)	0.970
TGDS (depression)	1.69 (0.59 – 4.82)	0.329
MNA (at risk of malnutrition)	2.70 (0.94 – 7.74)	0.065
Number of teeth (0 - 19)	1.44 (0.82 – 2.53)	0.206
POPs (0 - 3)	1.72 (1.01 – 2.90)	0.044

Table 2. Final binary logistic regression for factors related to pre-frailty/frailty.

Discussion

The prevalent rates of frail and pre-frail were 12.1% and 49.2%, respectively. A previous study in Nakhon Pathom, Thailand, using Fried'frailty phenotype, reported that the prevalent rates of frail and pre-frail were 22.7% and 55.3%, respectively,[29] which were higher than that of this study. According to the systematic review, the prevalence of frail and pre-frail among community-dwelling older adults in low-income and middle-income countries ranged from 3.9% to 51.4% and from 13.4% to 71.6%, respectively.[37] The corresponding values in the present study fell within this range.

The association of posterior occluding pairs with frailty and pre-frailty was found in this study. According to previous studies, the subjective and objective chewing ability were associated with frailty in community-dwelling older adults.[28,29,31] This masticatory function is clearly correlated with number of posterior teeth and occlusal relationships.[34] Chewing problems are the essential cause of altered food selections, possibly resulting in malnutrition and possibly representing the basis for a decline in general health.[36] As the cross-sectional survey in Japan, loss of natural teeth occlusion was a risk factor for malnutrition among community-dwelling frail older adults.[34]

After adjustment for socio-demographic and health variables, the number of teeth was not associated with frailty. This result is consistent with those of previous studies.[13,26,46] For the present study, some individuals with few or no natural teeth used dental prosthesis that might improve their chewing ability and consequently decreased the risk of malnutrition. Nevertheless, a 3-year cohort study in Mexico found that the number of teeth was associated with the development of frailty after controlling for confounders.[24]

Our study did not find associations of dysphagia and xerostomia with frailty status. Like the other studies, self-reported difficulty eating and dry mouth were not related to frailty.[13,24,26] For this study, it maybe that the majority of participants with these conditions only displayed mild symptoms. Therefore, these did not interfere with their daily activities. However, the prospective study showed that dry mouth was associated with incident frailty over 3 years of follow up.[26] Moreover, the cross-sectional in Japan revealed that dysphagia risk was independently associated with malnutrition among community-dwelling frail older adults.[35]

Inevitably, this study has some limitations. First, the sample size was too small. The present results should be cautiously interpreted due to their limited generalizability. Second, the cross-sectional design of the study does not allow the establishment of a causal relationship. Third, self-reported data on unintentional weight loss is less accurate. This was inevitable as we had no access to reliable databases. Nevertheless, in some cases, we could obtain the history of body weight from medical records to validate the reported data. Finally, we excluded older adults who were cognitive impaired and bedridden, the prevalence of frailty and pre-frailty may not reflect the actual prevalence among the older population in general.

Conclusions

The present study found that fewer posterior occluding pairs were significantly associated with frailty and pre-frailty among community-dwelling older adults, independent of socio-demographic and general health status. It is important to emphasize the maintenance of posterior occlusion. For the health care of this age group, a multidisciplinary approach is crucial. Further studies are required to explore the association between oral health and frailty.

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Declaration of Interest

The authors declare no conflict of interests.

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