Original Article

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Relationship between oral health status and nutritional status in a group of older persons: denture status

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Objective: The aim of the study was to investigate the effects of tooth loss, denture replacement, and denture status, i.e. retention, stability, occlusion and defect on nutritional status in the pre-ageing and ageing people residing at home.

Materials and Methods: This cross-sectional study was conducted in a rural area, northern Thailand. The study population (290 persons) comprised free living participants aged 50 years or more. Subjects (115 persons) aged 50-59 were the pre-ageing group and individuals (175 persons) aged 60 and over were the ageing group. Subjects had interviews, oral examinations, and denture examinations. The Short-Form Mini-Nutritional Assessment (MNA-SF) was used to assess nutritional status. Association between dentition status, denture status, and nutritional status were analyzed using Chi-square test and Fisher's exact test.

Results: Fifteen participants (13%) in the pre-ageing group and 50 participants (28.7%) in the ageing group used removable dentures. Among the participants who used dentures, all participants in the pre-ageing (15 persons) wore partial dentures while 36 participants (20.6%) in the ageing group wore partial dentures and 14 participants (8.0%) wore complete dentures. The results revealed that the state of tooth loss without denture replacement resulted in the lowest MNA-SF score in both pre-ageing and ageing groups. Higher scores were achieved in persons with removable denture replacement while persons with adequate dentition had the highest scores. The association between dentition status and nutritional status in the pre-ageing group was not found, but the statistically significant association existed in the ageing group ($p<0.05$). Additionally, the association between the denture status and nutritional status in both pre-ageing and ageing participants were not found ($p>0.05$).

Conclusion: To improve the quality of life of older persons, oral hygiene care and appropriate dental treatments should be emphasized to maintain natural dentition and prevent tooth loss. This strategy should be started before those adults reach their old age. In addition, dentists should provide appropriate dietary advice to denture wearers, especially in the ageing group, and encourage them to eat various foods by proper preparing so that they can have adequate nutrient content.

Keywords: adequate dentition, dentition status, denture status, nutritional status, older persons, removable denture replacement

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Introduction

Dental status is one of the important factors affecting dietary intake and nutritional status. Poor oral hygiene can contribute to plaque formation which can lead to gingivitis, periodontitis, tooth decay and loss of teeth. Loose teeth, painful teeth or ill fitting dentures may affect good appetite, cause difficulty in chewing and decrease ability to eat. These conditions may cause the elderly

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people avoid fresh fruits, raw vegetables and meats and change to soft and processed food. [1-3] These soft and processed foods are typically high in fat and cholesterol content. A research also demonstrates a tendency of higher intake of saturated fat and cholesterol among elders with fewer teeth. [4] In this regard, it should be concerned that tooth loss and subsequent changes in diet can increase the incidence of diseases among elderly people. [5-7] Thus, adequate nutrition is important for elderly people to promote the general health and quality of life. However, many reports have confirmed that the oral health of older persons is far from satisfactory. [8, 9] Therefore, as tooth loss occurs, diet quality also declines. [10] For this reason, it is dentists' responsibility to be conscious of the nutritional risk factor of the elderly people. Subsequent replacement of missing teeth with either a partial or complete denture can improve chewing efficiency, but mastication is less efficient than with intact natural dentition. In particular, the chewing function of a person with complete dentures is only one fifth of that of a dentate person [11] and the risk of nutritional problems persists. [12] Some studies have reported that there is a relationship between wearing removable prostheses and an inadequate dietary intake. [4, 13, 14] This functional impairment is shown to contribute to the reduction of muscular strength due to ageing. The maximum bite force is thought to be influenced by sensitivity of the mucoperiosteum covering the alveolar ridge which affects the individual threshold for discomfort. Loss of functional dentition may result in food selection and some food avoidance. This can lead to nutrition compromised. [15] Moreover, there is some evidence of denture characteristics on various mechanical limitations, particularly the influence of denture fit and adaptation, occlusal relationship, and denture tilting or slipping during function. [16] Some investigations reported that masticatory function will become better after improving the qualities of conventional removable dentures and contribute to the consumption of adequate nutrient. [17-20] Other studies stated that habits of food selection and food intake of older people with or without dentures do not change significantly, thus, nutritional status has not been improved. [21-25]

Generally, tooth loss negatively impacts physical health and it is a risk factor for malnutrition, disability, loss of self-esteem, and declining in quality of life. Therefore, detection of the effect of tooth loss, denture replacement and status of dentures on the nutritional status would enhance adequate general health and quality of life of older persons. Although a variety of investigations in dental status and nutritional status were performed earlier, little information has been reported on the influence of tooth loss, with or without denture replacement, and denture status on nutritional status. Furthermore, at present, there is no accordance in the results of the previous studies regarding the effect of denture replacement and nutritional status. Hence, it was the objective of this study to investigate the effect of tooth loss, denture replacement, and denture status (retention, stability, occlusion and denture defect) on nutritional status in the pre-ageing and ageing people residing at home.

Materials and methods

Study design and study population

This investigation was a cross-sectional study conducted in a rural area, northern Thailand (Tubtao subdistrict, Thoeng district, Chiangrai province). At the study period, older adults represent 17.8% of Tubtao's population, as compared with 17.1% of the total Thai population. Of the 1049 inhabitants aged 50 and over, the number of 290 participants was attained and the simple random sampling from the census registration was used to select the subjects. The present study was based on data collected in the project examining the effect of oral health status on nutritional status in a group of older persons. Complete details of the study are reported elsewhere. [26]

The inclusion criteria were that the subjects had no problem of cognitive impairment, were able to answer questions, and were willing to participate in the study. Persons who needed to have antibiotic prophylaxis to prevent infective endocarditis before being assessed the periodontal status using a CPI probe were excluded from the study. The study plan was approved by the Faculty of Dentistry/Faculty of Pharmacy, Mahidol University Institutional Review Board (COA.No.MU-DT/PY-IRB 2016/031.2606). The subjects were informed of the aims of the research. Written consent was obtained from participants or their representatives.

Classification of participants

The pre-ageing and ageing participants were categorized into 4 subgroups according to the teeth present and the need for denture replacement as follows:-

Subgroup 1 *Adequate dentition*: defined as persons with 12 anterior teeth and at least 4 posterior occluding pairs. This group was classified as no need of denture replacement. [27-29] Persons with fixed crown and bridge restorations were categorized as natural dentition.

Subgroup 2 *Partial denture replacement*: defined as persons with maxillary and/or mandibular partial denture replacement.

Subgroup 3 *Complete denture replacement*: defined as persons who had no natural teeth and had complete denture replacement.

Subgroup 4 *Need denture, no replacement*: defined as persons with less than 12 anterior teeth and/or 4 posterior occluding pairs. They needed dentures but did not have denture replacement.

Measurements

Prior to clinical examination, socio-demographic data were collected through interviews using a questionnaire, that comprised 38 questions assessing personal data, self-reported medical history, difficulties in chewing, feeling of mouth-dryness, food avoidance, and removable denture usage.

Nutritional status assessment

Nutritional status was assessed using the Thai version of the Short-Form Mini Nutritional Assessment (MNA-SF). The MNA-SF was considered as the gold standard appropriate for elderly population to identify individuals who were malnourished or at risk of malnutrition. [30] The MNA-SF consisted of 6 questions. The questions related to whether the amount of food intake decreased previously during 3 months, loss of weight within 3 months, ability to move independently, self-assessment of mental health, and measuring of body mass index (BMI). The score ranged from 0 to 14 points. Persons obtained 12-14 points were classified as normal nutrition, 8-11 points as at risk of malnutrition and 0-7 as malnutrition. [31, 32]

Dental and denture examination

The clinical examination was carried out in accordance with the World Health Organization criteria. [33] The examination was performed by two trained and calibrated investigators. To test inter-examiner reliability, the Kappa statistics was applied. The kappa index ranged from 0.83 to 0.87 was obtained and the values were considered as high consistency. [34] Oral health status was described as decay, periodontal condition with pocket depth, the number of present teeth per person and number of posterior functional units. Additional details of the study can be found elsewhere. [26]

In addition to the comprehensive oral examination, the presence of removable denture and removable denture status were also evaluated. Only the presence of denture, denture status, and the association between tooth loss with and without denture, denture status and nutritional status are presented in this current study.

To assess the status of removable denture, four denture parameters were determined:- denture retention, stability, occlusion and defects. The criteria for assessment were modified after Vigild [35] as follows:

Retention: The resistance to removal of *complete denture* was assessed by pulling the

denture in a direction opposite to that of its insertion. Retention was recorded as good if the denture resists the pulling force. Slight resistance to removal was recorded as fair. If the denture is removed from the supporting tissue easily, the denture had poor retention.

Retention of *partial denture* was assessed by an attempt to remove the denture in the direction opposite to that of its insertion. If the clasps provide resistance, retention was good. Less and no resistance was considered as fair and poor retention respectively.

Stability: The resistance against horizontal movements of *complete denture* was tested by placing light finger pressure bilaterally in the premolar regions, and an attempt was made to tip, rotate and displace the denture horizontally. The state of being firm and steady in position of the denture during application of force was examined and classified as good, fair and poor stability.

The stability of *partial denture* was considered good if they cannot be rocked to any appreciable extent by gentle digital pressure.

Occlusion: For participants wearing *complete dentures,* the opposing teeth should meet evenly on both sides of the dental arch and there was no movement of the denture base on the supporting tissue when the mandible was guided in the retruded position.

For participants wearing *partial denture,* both opposing natural teeth and denture teeth should meet evenly or maximally when the jaw was closed slowly. Simultaneous bilateral contacts of opposing posterior teeth should be obtained in centric occlusion for the distal extension partial denture and occlusion for tooth supported removable partial denture should be in harmony with natural dentition. The occlusion was graded as satisfactory if it met the criteria. If there was slight movement of the denture, occlusion was graded as unsatisfactory.

Defects: Defects were recorded as present or absent, and only major defects were recorded, i.e. broken denture base, broken denture tooth, dislodged denture tooth, broken or dislodged clasp arm and no replacement of additional extracted tooth.

The maxillary and mandibular dentures were separately determined for retention, stability and defect. If a participant wore both maxillary and mandibular dentures, the lower grade of the evaluation was considered as the parameter of the set of dentures. Regarding the parameter of occlusion, the maxillary and mandibular dentures were determined in the whole set at the same time.

Statistical analysis

The statistical analysis were performed using the Statistical Package for Social Sciences 18.0 (SPSS 18.0, SPSS Inc. Chicago, IL, USA). [36] In the initial stage, the descriptive analysis of each variable was made. Categorical data were presented as frequency distributed and percentage, continuous data were presented as mean (±SD). The association between dentition status, denture status, and nutritional status were assessed with Chi-square test. Fisher's exact tests were used instead of Chi-square tests in cases where there were less than five cases in a given cell. The results were considered as statistically significant at $p \leq 0.05$

Results

Socio-demographic characteristics and oral health status

Overall, 290 persons took part in this study. Among these participants, 115 persons (39.7%) were in the pre-ageing group with the mean age of 54.7±2.8 years (range 50-59 years) and 58 persons (50.4%) were female. The ageing group included 175 participants (60.3%), the mean age was 66.5±6.2 years (range 60-88 years) and 79 persons (45.1%) were female. Natural dentition could be observed in many participants while dental caries and periodontal pockets were important problems of them. The mean numbers of the retaining teeth were 25 (range 6-28) and 21 (range 0-28) for the pre-ageing and ageing groups, respectively (maximum=28 teeth). Fifteen

participants (13%) in the pre-ageing group and 50 participants (28.7%) in the ageing group used removable dentures. Among the participants who used dentures, all participants in the pre-ageing (15 persons) wore partial dentures while 36 participants (20.6%) in the ageing group wore partial dentures and 14 participants (8.0%) wore complete dentures. The mean age of existing dentures was 4.4±3.1 (range 1-10 years) and 4.3±2.1 years (range 1-10 years) for the pre-ageing and ageing groups, respectively. A large percentage of participants (21.7% in the pre-ageing group and 18.3% in the ageing group) needed denture but did not have denture replacement. The number of participants classified according to the dentition status into 4 subgroups including 1) adequate dentition 2) partial denture replacement 3) complete denture replacement and 4) need denture, no replacement is shown in Table 1.

Denture status

The maxillary and mandibular dentures were clinically assessed for retention, stability, occlusion and defects. The results are presented in Table 2. In the pre-ageing group, most partial dentures had fair retention (40.0%), either fair or poor stability (46.7%), satisfied occlusion (80.0%) and more than half of them (53.3%) had no defect. In the ageing group, most of partial and complete dentures had fair retention (36% and 16%), fair stability (42% and 14%), satisfied occlusion (50% and 22%) and no defect (54% and 20%), respectively.

Nutritional status

The MNA-SF scores of the pre-ageing and ageing participants are shown in Table 3. The highest MNA-SF scores were found in the subgroup “adequate dentition” of both pre-ageing and ageing groups (11.96±2.04 and 11.83±1.86 respectively). The participants in the subgroup “need denture, no replacement” of both pre-ageing and ageing groups had the lowest scores (10.44±2.14 and 9.13±2.52 respectively). Table 4 represents the number of participants categorized according to the nutritional status. According to the low prevalence of malnutrition in both pre-ageing and ageing groups, the data of “malnutrition” were added up to “risk of malnutrition” for statistical analysis and represented as “risk of malnutrition and malnutrition”. There was a general trend of risk of malnutrition and malnutrition in the pre-ageing (46.1%+3.5% = 49.6%) and ageing (49.1%+5.8% = 54.9%) groups described by MNA-SF. (Table 4) It can be seen that though the participants had adequate dentition, surprisingly, the number of normal nutrition (33.9% in pre-ageing and 28.6% in ageing) was nearly similar to the number of “risk of malnutrition and malnutrition” (30.4+0.9 = 31.3% in pre-ageing and 24.0+0.6 = 24.6% in ageing). In addition, in the subgroup “need denture, no replacement” the number of participants with “risk of malnutrition and malnutrition” (11.3+1.7 = 13.0% in pre-ageing and 11.4+2.3 = 13.7% in ageing) was greater than those with “ normal nutrition” (8.7% in pre-ageing and 4.6% in ageing).

Table 1 Number and percentage of participants classified according to dentition status.

Group of dentition	Number of participants	
	Pre-ageing (n=115)	Ageing (n=175)
Adequate dentition (AD)	75 (65.2%)	93 (53.1%)
Partial denture replacement (PDR)	15 (13.1%)	36 (20.6%)
Complete denture replacement (CDR)	0	14 (8.0%)
Need denture, no replacement (NR)	25 (21.7%)	32 (18.3%)
Total	115	175

Table 2 Number and percentage of participants classified according to denture status.

Denture status	Pre-ageing (n=15)	Ageing (n=50)	
	Partial denture (n=15)	Partial Denture (n=36)	Complete denture (n=14)
Retention			
Good	5 (33.3%)	8 (16.0%)	3 (6.0%)
Fair	6 (40.0%)	18 (36.0%)	8 (16.0%)
Poor	4 (26.7%)	10 (20.0%)	3 (6.0%)
Stability			
Good	1 (6.6%)	7 (14.0%)	5 (10.0%)
Fair	7 (46.7%)	21 (42.0%)	7 (14.0%)
Poor	7 (46.7%)	8 (16.0%)	2 (4.0%)
Occlusion			
Satisfied	12 (80.0%)	25 (50.0%)	11 (22.0%)
Unsatisfied	3 (20.0%)	11 (22.0%)	3 (6.0%)
Defects			
No	8 (53.3%)	27 (54.0%)	10 (20.0%)
yes	7 (46.7%)	9 (18.0%)	4 (8.0%)

Table 3 MNA-SF scores* (0-14 points) distributed according to dentition status of pre-ageing and ageing participants.

Group of dentition	MNA-SF score			
	Number of participants	Mean ± SD	Minimum score	Maximum score
Pre-ageing				
Adequate dentition	75	11.96 ± 2.04	6	14
Partial denture replacement	15	11.27 ± 2.05	6	14
Need denture, no replacement	25	10.44 ± 2.14	5	14
Total	115			
Ageing				
Adequate dentition	93	11.83 ± 1.86	5	14
Partial denture replacement	36	10.97 ± 2.15	5	14
Complete denture replacement	14	10.29 ± 2.99	4	14
Need denture, no replacement	32	9.13 ± 2.52	4	14
Total	175			

*MNA-SF score ≥ 12 points = Normal nutrition
8-11 points = At risk of malnutrition
≤ 7 points = Malnutrition

Table 4 Number and percentage of participants categorized according to the nutritional status.

Group of dentition	Nutritional Status		
	Normal nutrition	Risk of malnutrition	Malnutrition
Pre-ageing (n=115)	58 (50.4%)	53 (46.1%)	4 (3.5%)
Adequate dentition (n=75)	39 (33.9%)	35 (30.4%)	1 (0.9%)
Partial denture replacement (n=15)	9 (7.8%)	5 (4.3%)	1 (0.9%)
Need denture, no replacement (n=25)	10 (8.7%)	13 (11.3%)	2 (1.7%)
Ageing	79 (45.1%)	86 (49.1%)	10 (5.8%)
Adequate dentition (n=93)	50 (28.6%)	42 (24.0%)	1 (0.6%)
Partial denture replacement (n=36)	16 (9.1%)	17 (9.7%)	3 (1.7%)
Complete denture replacement (n=14)	5 (2.9%)	7 (4.0%)	2 (1.1%)
Need denture, no replacement (n = 32)	8 (4.6%)	20 (11.4%)	4 (2.3%)

Association between dentition status, denture status, and nutritional status

The association between the characteristics of the participants and nutritional status and oral health status and nutritional status is reported in the study of Tubtimtong et al. [26] which can be concluded as follows: in the pre-ageing group, the living condition (stay alone or with family) and the periodontal pockets had significant relation to nutrition status (p=0.045 and 0.047, respectively). In the ageing group, gender was correlated with nutritional status (p<0.0001) and female participants were likely to have risk of malnutrition and malnutrition. Other factors such as periodontal pockets, number of natural teeth (≥20 and < 20 teeth) and type of functional units categorized as natural maxillary teeth occluding with natural mandibular teeth showed significant relation with nutritional status (p <0.05). Questions from MNA-SF related to weight loss and changes in food intake had highly significant relation to nutritional status in both pre-ageing and ageing groups (p = 0.00). In this current study, the statistically significant association between dentition status and nutritional status was found in the ageing group only (p = 0.036). (Table 5) When determining the relationship of denture status and nutritional status, the results revealed that the association between denture status and nutritional status was not found in both pre-ageing and ageing groups (p>0.05) . (Table 6, 7)

Discussion

The present study is a part of the investigation examining the effect of oral health status on nutritional status. This study investigated nutritional assessment using the MNA-SF in a group of Thai adults of pre-ageing (50-59 years) and ageing group (≥60 years) who had adequate dentition, and who had tooth loss with and without denture replacement. Therefore, apart from the relationship between denture status and nutritional status, the impact of age on denture replacements for missing teeth on nutritional status has also been studied.

Table 5 Relationship between dentition status and nutritional status.

Group of dentition	Nutritional Status		X^2-test *p*-value
	Normal nutrition	Risk of malnutrition and malnutrition	
Pre-ageing			
Adequate dentition (n=75)	39 (33.9%)	36 (31.3%)	0.43
Partial denture replacement (n=15)	9 (7.8%)	6 (5.3%)	
Need denture, no replacement (n=25)	10 (8.7%)	15 (13.0%)	
Total	58 (50.4%)	57 (49.6%)	
Ageing			
Adequate dentition (n=93)	50 (28.6%)	43 (24.6%)	0.036*
Partial denture replacement (n=36)	16 (9.1%)	20 (11.4%)	
Complete denture replacement (n=14)	5 (2.9%)	9 (5.2%)	
Need denture, no replacement (n = 32)	8 (4.6%)	24 (13.7%)	
Total	79 (45.1%)	96 (54.9%)	

Table 6 Relationship between denture status and nutritional status of participants in pre-ageing group.

Denture status	Nutritional status		Total	Fisher's exact test *p*-value
	Normal nutrition	Risk of malnutrition and malnutrition		
Partial denture replacement (n=15)				
Retention				0.15
Good	2	3	5	
Fair	3	3	6	
Poor	4	0	4	
Stability				0.39
Good	4	3	7	
Fair	5	2	7	
Poor	0	1	1	
Occlusion				0.79
Satisfied	7	5	12	
Unsatisfied	2	1	3	
Defect				0.21
No	6	2	8	
Yes	3	4	7	

Table 7 Relationship between denture status and nutritional status of participants in ageing group.

Denture status	Nutritional status		Total	Fisher's exact test *p*-value
	Normal nutrition	Risk of malnutrition and malnutrition		
Partial denture replacement (n=36)				
Retention				
Good	5	3	8	0.51
Fair	7	11	18	
Poor	4	6	10	
Stability				
Good	4	3	7	0.73
Fair	9	12	21	
Poor	3	5	8	
Occlusion				
Satisfied	10	15	25	0.42
Unsatisfied	6	5	11	
Defect				
No	12	15	27	0.94
Yes	4	5	9	
Complete denture replacement (n=14)				
Retention				
Good	2	1	3	0.45
Fair	2	6	8	
Poor	1	2	3	
Stability				
Good	2	3	5	0.83
Fair	2	5	7	
Poor	1	1	2	
Occlusion				
Satisfied	4	7	11	0.92
Unsatisfied	1	2	3	
Defect				
No	3	7	10	0.57
Yes	2	2	4	

The participants in pre-ageing and ageing groups were categorized into 4 subgroups according to the teeth present and the need for denture replacement. The criterion of the subgroup "adequate dentition" was related to no need to teeth replacement because the esthetics and masticatory function were acceptable. [27] The participants who had inadequate dentition were divided into 3 subgroups including "need denture, no replacement", "partial denture replacement", and "complete denture replacement". Though replacement of missing teeth with either removable partial denture or complete denture seemed to improve masticatory function [37], in this present study, there was a limitation in this improvement and the risk of malnutrition and malnutrition persisted as shown in Table 4. In addition, Wayler et al found that persons who wear at least one complete denture generate markedly lower chewing performance than persons with intact natural dentition and persons with partial denture. [38-40] Hence, to examine the data in this study, participants who had complete denture replacement were categorized into different subgroup with those who had partial denture replacement.

Adequate natural dentition was found more than half of the participants (65% in pre-ageing group and 53% in ageing group). However, the results did not meet the planning goal of the World Health Organization [41] which proposed that 80% of the elders should have 20 natural teeth. Though the Ministry of Public Health of Thailand had launched a programme of providing acrylic dentures for adults and older adults for free for more than 10 years, there were 22% of the pre-ageing and 18% of the ageing persons who needed dentures but did not have denture replacement. The need for prosthodontic treatment decided by dentists may be different from the perceived need recognized by the individual. [35, 42]

In this study, the results revealed that there was no association between dentition status and nutritional status in the pre-ageing group (p= 0.43), while significant difference was found in the ageing group (p=0.036). Better adaptive capacity of the pre-ageing group could probably be the reason. It is well accepted that the successful outcome of prosthetic treatment, especially with removable dentures, depends mostly on whether the individual is able to adapt and habituate to wearing the dentures. However, adaptive capacity to new dentures tends to decrease with age which probably results from progressive loss of neurons from central nervous system, leading to a decreased ability to form new reflex arcs. [43] According to decreased adaptability in old age, older adults may take time to learn and gain experience in chewing performance when they lose their natural dentition. Therefore, poor oral health and loss of natural teeth with or without denture replacement among older persons might be a major public health concern. To improve the quality of life of older persons, oral hygiene care and appropriate dental treatments should be emphasized to maintain natural dentition and prevent tooth loss. This strategy should be started before those adults reach their old age. Natural teeth that are too weak to serve as abutments for removable partial dentures can be used for support of overdenture, since shortened retained teeth have an improved crow-root ratio. Support from the remaining roots helps to protect the residual ridge from resorption and provide better denture retention. [44, 45]

Moreover, the results of this study showed that there was significant association between dentition status and nutritional status in the ageing group which was in agreement with the investigation of McKenna et al [19], Prakash et al [20], De Marchi et al [46], and Jauhiainen L et al [47]. They reported that nutritional status of the elders who wore dentures tended to be better than those with compromised dentition but not as good as those with adequate dentition and denture wearers chose food which were less dietary quality than those with adequate dentition. A prior study by Wallace S et al [48] concluded that enhancing masticatory performance by removable partial denture alone does not

improved nutritional status of older patients. Moreover, Cousson et al [23] reported that denture usage can increase the risk of malnutrition in older persons. The results of the present study were in agreement with the investigations of those mentioned authors because malnutrition could be found in denture wearers and no denture replacement groups. In addition, some studies [17, 21, 22, 24] did not find major differences in nutrient intakes among older persons who used dentures. Even though the masticatory efficiency improved, it did not motivate the elders to change their diet. Dietary intake seems to be influenced by not only chewing ability but also some other determinants of food choice such as economic status, education, social isolation, nutritional limitation due to physical health and personal eating habit and food preference. [17, 19] Hence, dietary advice considering for all factors that affect individual food selection should be provided to the elders after receiving new prosthesis and they should be made aware of the need to change dietary intakes.

Though deficiencies in denture retention and stability are the common denture problems that affect chewing capacity, improving the denture quality should help better dietary intake. This study has shown that the quality of dentures had no association with nutritional status in both pre-ageing and ageing groups. This result was in agreement with the study of Shinkai et al. [37] They concluded that the provision of technically perfect dentures is not important to diet quality though the masticatory performance has been improved. This is in contrast to the study of Marshall et al [18] who reported that the presence of natural teeth and well fitting dentures were associated with various nutrient intakes and could improve dietary quality in older persons.

There are a few limitations in this study. First, this research was the cross-sectional study which allows for associations to be investigated but does not provide the causes of associations and the effect of relationships. Further longitudinal research should be conducted to confirm the association between oral health status, denture status and nutritional status of these participants. Second, The strength of this study was affected by the small sample size assembled during the study period, which is affected by the actual low proportion of participants who used removable denture in both pre-ageing and ageing group. Third, the MNA-SF does not provide a direct assessment of malnutrition. It could only describe the nutritional status as normal, at risk of malnutrition and malnutrition. [31, 32] When individuals were evaluated as at risk of malnutrition or malnutrition, especially those who had weight loss or changes in food intake, they should have further assessment by physicians or dieticians.

Conclusion

According to the objectives of the study, the results indicate that the state of tooth loss without denture replacement affects the MNA-SF score in both pre-ageing and ageing groups. Better scores were achieved in persons with removable denture replacement while persons with adequate dentition had the highest scores. There was no association between dentition status and nutritional status in the pre-ageing group but statistically significant association existed in the ageing group. Additionally, when determining the association between the quality of dentures in terms of retention, stability, occlusion and denture defect with the nutritional status, no relationship was found in both pre-ageing and ageing participants. Apart from chewing ability, nutritional deficiency seems to be influenced by many determinants of food choice, e.g., economic status, education, social isolation, physical health and personal eating habit and food preference. Although the results of this study could not show correlation between dentition status and specific nutrient intake, the delivery of dentures to older adults could

compromise food selection. This study suggests that natural teeth should be kept as long as possible so that the elders do not restrict food choice. In addition, when removable dentures cannot be avoided, dentists should provide appropriate dietary advice to denture wearers, especially in the ageing group, and encourage them to eat all kinds of food by proper preparing or adapting such as cutting, slicing, and chopping it into small pieces so that they can have adequate nutrient content.

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