ORIGINAL ARTICLE

Correlation between the number of teeth in older adults and nutritional status and cognitive function: a cross-sectional study

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ABSTRACT

Introduction: Aging is associated with various changes in body tissues and organs, including the oral cavity, among older adults. A common oral problem among older adults is tooth loss. The number of teeth in older adults is related to nutritional status and cognitive function. Previous studies examining the relationship between the number of remaining teeth, nutritional status, and cognitive function among older adults have reported mixed findings. While some studies have identified an association among these variables, others have reported different results. These inconsistencies indicate that the relationship among these variables warrants further investigation. In this study, oral health was assessed based on the number of remaining teeth, while cognitive function was evaluated using the Mini-Cog and Clock Drawing Test. Therefore, this study aimed to analyze the correlation between oral health, nutritional status, and cognitive function among older adults. **Methods**: This analytical observational study employed a cross-sectional design and included 110 older adults aged ≥ 60 years with varying numbers of remaining teeth. Participants were selected using purposive sampling according to predefined inclusion and exclusion criteria. Participants underwent an intraoral examination to determine the number of remaining teeth. Nutritional status was assessed using the Mini Nutritional Assessment (MNA) Long Form and classified as good nutritional status, at risk of malnutrition, or malnourished. Cognitive function was assessed using the Mini-Cog and Clock Drawing Test and classified as normal cognitive function or cognitive impairment. Spearman's correlation test was used to analyze the correlation between the number of remaining teeth among older adults and nutritional status and cognitive function. **Results**: Among older adults with ≥ 20 remaining teeth, most had good nutritional status and normal cognitive function. The number of remaining teeth was significantly and positively correlated with nutritional status (Spearman's $\rho = 0.327$, $p < 0.001$). A significant positive correlation was also observed between the number of remaining teeth and cognitive function (Spearman's $\rho = 0.534$, $p < 0.001$). **Conclusions**: The number of remaining teeth was correlated with nutritional status and cognitive function among older adults.

KEYWORDS

Aged, dentition, nutritional status, cognition

INTRODUCTION

Population ageing has become a global phenomenon and one of the major public health challenges worldwide. According to the United Nations, approximately 703 million people aged 65 years and older were living worldwide in 2019, and this number is projected to double by 2050. Along with the growing

older adult population, maintaining health and quality of life in later life has become increasingly important.[1]

Indonesia is also experiencing a rapid increase in its older adult population. Indonesia entered the ageing population phase in 2021.[2] Based on projections by the Central Statistics Agency (BPS) in 2023, the older adult population in Indonesia is estimated to reach 65.82 million in 2045, equivalent to 20.31% of the total population. This demographic transition is inevitable given the current population structure, which is characterized by a large productive-age population and a continuously increasing life expectancy.[2-3] In Indonesia, individuals aged 60 years and older are categorized as older adults.[4]

As people age, various physiological changes occur and may lead to a decline in organ function, including changes in the oral cavity. One of the most common oral health problems among older adults is tooth loss. Data from the Global Burden of Disease (GBD) 2021 study estimated that approximately 353 million people worldwide were affected by edentulism, with its prevalence increasing with age and exceeding 30% among individuals aged 80 years and older.[5]

Tooth loss is defined as the loss of one or more teeth from the dental arch, which can be caused by various complex factors such as complications from systemic diseases, trauma, caries, and periodontal disease.[6-7] Age is an important factor associated with tooth loss among older adults. Tooth loss in older adults is commonly related to the cumulative effects of oral diseases, particularly dental caries and periodontal disease, which may progressively affect oral health over time.[8]

However, the main causes of tooth loss are caries and periodontal disease.[7] Periodontal diseases commonly found in older adults are gingivitis and periodontitis. Older adults are more susceptible to periodontitis, which can lead to tooth loss due to several predisposing factors, such as poor oral hygiene, decreased immune system function, underlying systemic diseases, and unhealthy lifestyles, such as smoking and alcohol consumption. [7–9]

Tooth loss can cause various problems, one of which is reduced masticatory ability. This affects dietary restrictions and reduces the intake of nutrients needed by the body. Chewing disorders and dietary restrictions are generally associated with the loss of posterior teeth, which are used for chewing.[10] Previous studies have shown that a reduction in the number of posterior teeth decreases occlusal pressure and causes loss of posterior tooth contact, which can interfere with the process of food grinding and chewing, thereby reducing vitamin and fiber intake.[11,12]

Although older adults who have lost teeth are still able to consume high-fiber and high-calorie foods, they tend to switch from hard foods that are difficult to chew to softer foods that are easier to swallow. This decline in chewing ability has the potential to cause poor nutritional status in older adults.[11,12] This condition is concerning because nutritional status plays an important role in determining health and quality of life among older adults. Adequate nutritional intake is essential for maintaining physical function, supporting immune function, preserving independence, and promoting healthy aging. Conversely, poor nutritional status among older adults is associated with physical decline, increased susceptibility to disease, and reduced quality of life.[13]

However, these findings are not in line with those of previous studies reporting that the majority of older adults experience difficulties in chewing food due to the loss of many posterior teeth, but this condition does not affect the quality of the food they consume. This is because older adults still have a number of teeth in their oral cavity, allowing them to occasionally consume hard foods as well as high-fiber and high-calorie foods.[12]

Older adults with chewing limitations due to tooth loss can also maintain their nutritional status by using dentures, as the proper use of dentures can help improve chewing efficiency, which indirectly affects food intake, as well as by adjusting eating patterns, such as cooking food for longer or cutting it into smaller pieces, and supporting nutritional intake with the consumption of whey protein-based milk enriched with leucine and vitamin D to help meet protein requirements and reduce the risk of malnutrition.[10,14]

In addition to impacting nutritional status, the number of teeth remaining in older adults is also associated with other health aspects. Cognitive function represents an essential component of healthy aging, as it enables older adults to maintain independence, perform daily activities, and preserve quality of life. Conversely, deterioration in cognitive function may lead to functional limitations, reduced autonomy, and increased dependence among older adults.[15]

The loss of teeth among older adults can increase the risk of cognitive decline due to impaired masticatory function. This is because tooth loss interferes with the masticatory process, which can result in reduced chewing sensory input to the brain. Optimal masticatory function requires complex coordination between the teeth, the temporomandibular joint (TMJ), masticatory muscles, blood vessels, and nerves.[16] Previous studies have reported that older adults with very few teeth (0–12 teeth) have a higher risk of cognitive impairment than older adults who still have more teeth (13–32 teeth).

In addition, cognitive decline can also be influenced by a lack of essential nutrients, such as vitamin B12, which plays a role in maintaining nerve health and brain function. Therefore, missing teeth should be replaced with prostheses to prevent problems with the main functions of teeth, namely phonetics, mastication, aesthetics, and cognitive function.[17]

Previous studies have primarily examined the association between tooth loss and either nutritional status or cognitive function among older adults. However, limited evidence is available on the association between the number of remaining teeth and both nutritional status and cognitive function assessed simultaneously, particularly among older adults living in social welfare homes in Indonesia. Therefore, this study aimed to analyze the correlation between oral health, nutritional status, and cognitive function among older adults.

METHODS

This cross-sectional study was conducted in West Jakarta from August to September 2025. The study population comprised 455 older adults residing in the Budi Mulia 2 Social Welfare Homes in Cengkareng (n = 350) and Jelambar (n = 105). Although the total number of older adults in both facilities was known, the proportion of eligible participants who met the inclusion criteria and were available for participation could not be determined prior to data collection. Therefore, the Lemeshow formula was used to estimate the minimum required sample size, as it is appropriate when the population characteristics or expected proportion of the target outcome are unknown.

Based on a 95% confidence level (Z = 1.96), an estimated proportion of 0.5, and a 10% margin of error (d = 0.1), the calculated sample size was 96.04. This value was rounded up to determine the final minimum sample size of 97 respondents. This number was increased to 107 participants to account for potential non-response or incomplete data. Using purposive sampling, 110 older adults who fulfilled the study criteria and agreed to participate were included in the study. Thus, the final sample size exceeded the minimum required sample size. The inclusion criteria were older adults aged ≥60 years with stable physical

and mental conditions who were able to communicate verbally. Older adults who refused the oral examination, were uncooperative, or had systemic diseases, such as hypertension or diabetes mellitus, were excluded.

The data collection methods used included intraoral examinations, nutritional status questionnaire interviews, and cognitive function tests. Older adults aged ≥60 years who resided in the Budi Mulia 2 Social Welfare Homes in Cengkareng and Jelambar and met the predefined inclusion and exclusion criteria were enrolled in the study. The study was explained to eligible residents during a group session and subsequently to each participant individually before data collection. Participants were informed about the study objectives, procedures, potential benefits, the voluntary nature of participation, and their right to refuse or withdraw from the study at any time without consequences. Written informed consent was obtained from all participants before data collection.

Data were collected directly at the study sites through physical examinations and individual interviews. Physical examinations were conducted by two nurses from the local community health centre and included blood pressure measurement, measurement of body weight and height for body mass index calculation, measurement of mid-upper arm and calf circumferences, and visual oral examination to determine the number of remaining teeth. The number of remaining teeth was determined by direct visual inspection of the oral cavity and manual counting using a dental mirror and a penlight.

Nutritional status was assessed using the MNA Long Form, which consisted of an initial screening section followed by a detailed assessment section. Cognitive function was assessed individually using the Mini-Cog and Clock Drawing Test, which consisted of a three-word recall task, a clock drawing test, and delayed word recall. The researcher and four team members conducted the individual interviews and recorded participants' responses using standardized data collection forms.

All assessments were conducted individually in a comfortable and quiet setting. Participants were given clear instructions, adequate time to respond, and rest periods when needed. To minimize measurement and interviewer bias, standardized procedures, scoring criteria, measurement instruments, and data collection forms were used for all participants. Participants were instructed to open their mouths, and the number of visible natural teeth was determined through direct visual examination. The researcher and four interviewers also participated in a calibration session to standardize the wording and sequence of questions, the instructions provided to participants, and the scoring procedures for the MNA-LF and Mini-Cog and Clock Drawing Test. This procedure was implemented to ensure consistency across interviewers and to minimize interviewer bias.

Nutritional status was assessed using the Mini Nutritional Assessment–Long Form (MNA-LF), a comprehensive nutritional assessment tool consisting of 18 items. The MNA-LF was developed by Guigoz, Vellas, and Garry and has been validated for evaluating nutritional status among older adults. This instrument has been widely used in geriatric populations to assess and classify nutritional status among older adults.[18]

The first section comprised six screening items, followed by a detailed assessment section consisting of 12 items. The MNA-LF assessed four domains: anthropometric assessment, including body weight, height, body mass index, weight loss, mid-upper arm circumference, and calf circumference; general assessment, including lifestyle, medication use, mobility, and psychological or neuropsychological conditions; dietary assessment, including food and fluid intake, meal frequency, and independence in feeding; and subjective assessment, including self-perceived health and nutritional status. Based on the total MNA-LF

score, nutritional status was classified as good nutritional status (24–30), at risk of malnutrition (17–23.5), or malnourished (<17).[19]

In addition to assessing nutritional status, cognitive function in older adults was also evaluated using the Mini Cog and Clock Drawing Test. The Mini Cog and Clock Drawing Test is a brief cognitive screening tool originally developed by Borson et al. in 2000.[20] Respondents were first asked to memorize three words, then draw a complete clock with numbers and hands showing eleven past ten (11:10), after which they were asked to repeat the three words given earlier to assess memory function. In the Mini Cog and Clock Drawing Test, word recall scores were assigned one point for each word successfully remembered (0-3), whereas the Clock Drawing Test (CDT) was assigned two points if the clock drawing met normal criteria (numbers 1-12 complete and regular, with the hands showing 11:10) and zero points if it did not meet the criteria.[21] The total score was the sum of the three-word recall score (0-3) and the CDT score (0 or 2), with a maximum score of 5.[22]

In this study, the independent variable was the number of teeth among older adults. The number of teeth was categorized as <20 teeth (decreased chewing function) and ≥20 teeth (normal chewing function).[23] Meanwhile, the dependent variables were nutritional status and cognitive function. Information on denture use and dietary adaptations, such as food texture modification and consumption of special milk for older adults, was also collected because these factors may affect the relationship between the number of teeth and nutritional status and cognitive function. Older adults with fewer teeth may compensate for reduced chewing ability through the use of dentures, food texture modification, or nutritional supplementation, thereby helping to maintain adequate nutritional intake despite tooth loss.

Data were entered and analyzed using statistical software. Descriptive analysis was performed to examine the distribution of each variable and was presented in tabular form. Data analysis included univariate and bivariate analyses, and bivariate analysis was used to assess the relationship between the number of teeth in older adults and nutritional status and cognitive function using Spearman's correlation test. Spearman's rank correlation test was used because the study variables were analyzed as ordinal categories.

The number of remaining teeth was categorized as <20 teeth and ≥20 teeth; nutritional status was classified as malnourished, at risk of malnutrition, or good nutritional status; and cognitive function was classified as cognitive impairment or normal cognitive function. This test was used not only to assess the presence of associations but also to quantify the direction and strength of the monotonic relationships between the variables, as indicated by Spearman's rho.

RESULTS

Respondent characteristics are presented in Table 1. The majority of respondents were older adults, comprising 86 individuals (78.2%), with the largest proportion being male (55.5%). Most respondents had a low level of education, with 52 respondents (47.3%) having completed elementary school education, 18 respondents (16.4%) having completed junior high school education, and 2 respondents (1.8%) having never attended formal education. Based on blood pressure, the majority of the older adults were in the normal category (72.7%). In addition, 101 respondents (91.8%) did not use dentures, while among denture users, the majority used complete dentures. Most respondents also had fewer than 20 remaining teeth, with 79 respondents (71.8%). Based on the distribution of the number of teeth, the highest number of

remaining teeth was found in the anterior mandible, with 84 respondents (76.4%). Conversely, tooth loss was most frequent in the anterior maxilla, affecting 40 respondents (36.4%).

Table 1. Frequency distribution of respondents' characteristics

Variable	Frequency	Percentage (%)
Age		
Elderly	86	78.2
Old	24	21.8
Gender		
Male	61	55.5
Female	49	44.5
Level of education		
No schooling	2	1.8
Elementary School	52	47.3
Junior High School	18	16.4
Senior High School	28	25.5
Three-year Diploma	2	1.8
Bachelor's Degree	8	7.3
Blood pressure		
Normal	80	72.7
Hypertension	30	27.3
Use of dentures		
Yes	9	8.2
No	101	91.8
Type of dentures		
Complete denture	6	66.7
Removable partial denture	1	11.1
Combination denture	2	22.2
Number of remaining teeth		
<20 teeth	79	71.8
≥20 teeth	31	28.2
Distribution of remaining teeth		
Anterior maxilla	70	63.6
Posterior maxilla	73	66.4
Anterior mandible	84	76.4
Posterior mandible	74	67.3
Distribution of tooth loss		
Anterior maxilla	40	36.4
Posterior maxilla	37	33.6
Anterior mandible	26	23.6
Posterior mandible	36	32.7

Based on the results of data analysis presented in Table 2, all respondents were assessed for nutritional status and cognitive function. The nutritional status assessment showed that 6 respondents (5.5%) were malnourished, 45 respondents (40.9%) were at risk of malnutrition, and 59 respondents (53.6%) had good nutritional status. Meanwhile, the cognitive function assessment showed that the majority of respondents, namely 64 (58.2%), had cognitive impairment, while 46 (41.8%) had normal cognitive function.

Table 3 presents the relationship between the number of teeth and nutritional status among older adults. The results showed that the proportion of older adults with ≥20 teeth who had good nutritional status (80.6%) was much higher than the proportion of those with <20 teeth (43%). Conversely, the proportion of older adults with fewer than 20 teeth who were at risk of malnutrition (50.6%) and who were malnourished (6.3%) was higher than the proportion of those with ≥20 teeth (16.1% and 3,2%, respectively).

Table 2. Frequency distribution of nutritional status and cognitive function

Variable	Frequency	Percentage (%)
Nutritional status		
Malnutrition	6	5.5
Risk of malnutrition	45	40.9
Good nutritional status	59	53.6
Cognitive function		
Cognitive impairment	64	58.2
Normal cognitive function	46	41.8

Table 3. Relationship between the number of teeth and nutritional status

Number of teeth	Nutritional status			ρ (95% CI)	p-value
	Malnutrition (%)	At Risk of malnutrition (%)	Good nutritional status (%)		
<20 teeth	5 (6.3)	40 (50.6)	34 (43.0)		
≥20 teeth	1 (3.2)	5 (16.1)	25 (80.6)		
				0.327 (0.143-0.489)	<0.001

These findings suggest that older adults with fewer than 20 teeth were at higher risk of nutritional problems. Spearman's correlation test showed a significant positive relationship between the number of teeth and nutritional status (*rho* = 0.327; p < 0.001). A correlation coefficient of 0.327 indicated that the more teeth an older adult had, the better their nutritional status tended to be, although the strength of the relationship was relatively weak.

The relationship between the number of teeth and cognitive function is presented in Table 4. The results of the analysis showed that the proportion of older adults with ≥20 teeth who had normal cognitive function (83.9%) was much higher than that of older adults with <20 teeth (25.3%). Conversely, the proportion of older adults with fewer than 20 teeth who experienced cognitive impairment (74.7%) was higher than that of older adults with 20 or more teeth (16.1%). This significant difference in proportion indicated that the number of teeth among older adults was closely related to their cognitive function. Spearman's correlation test showed a significant positive relationship between the number of teeth and cognitive function (*rho* = 0.534; p < 0.001). A correlation coefficient of 0.534 indicated a moderate relationship, suggesting older adults with more teeth tended to have better cognitive function.

Table 4. Relationship between the Number of Teeth and Cognitive Function

Number of teeth	**Cognitive function**		**ρ (95% CI)**	**p-value**
	Cognitive impairment (%)	Normal cognitive function (%)		
<20 teeth	59 (74.7)	20 (25.3)		
≥20 teeth	5 (16.1)	26 (83.9)		
			0.534 (0.381-0.659)	p < 0.001

Further analysis was conducted to evaluate the relationship between nutritional status and cognitive function, which is presented in Table 5. The results showed that the proportion of older adults with good nutritional status who had normal cognitive function (59.3%) was higher than that of older adults who were at risk of malnutrition (22.2%) and older adults who were malnourished (16.7%). Conversely, the proportion of older adults with cognitive impairment was higher in the malnourished group (83.3%) and the group at risk of malnutrition (77.8%) compared with the good nutritional status group (40.7%).

These findings showed a clear pattern that the worse an individual's nutritional status, the higher the risk of cognitive impairment. Spearman's

correlation test showed a significant positive relationship between nutritional status and cognitive function (*rho* = 0.379; p < 0.001). These findings indicated that older adults with better nutritional status tended to have better cognitive function.

Table 5. Relationship between nutritional status and cognitive function

Nutritional status	Cognitive function		*ρ* (95% CI)	p-value
	Cognitive impairment (%)	Normal cognitive function (%)		
Malnutrition	5 (83.3)	1 (16.7)		
At risk of malnutrition	35 (77.8)	10 (22.2)		
Good nutritional status	24 (40.7)	35 (59.3)		
			0.379 (0.201-0.533)	P < 0.001

DISCUSSION

The results of this study describe the demographic characteristics of the respondents, including age, gender, education level, blood pressure, and denture use (Table 1). The age range of the respondents was between 60 and 89 years, with an average age of 69.08 years. Based on gender, the number of male respondents was slightly higher than the number of female respondents. According to information provided by the Budi Mulia 2 Cengkareng and Jelambar Nursing Home, this finding is thought to be related to the tendency of older men to be more active in participating in various activities than older women. This is in line with previous studies reporting that the level of participation of older women in various activities tends to be lower than that of older men.[24]

Most respondents had a low level of education. This finding is consistent with previous studies reporting that the majority of older adults in Indonesia still have low levels of education.[25] Data from Statistics Indonesia (Badan Pusat Statistik [BPS]) also show that the older adult population is dominated by individuals with limited education, with 28.89% not completing elementary school and 11.04% not attending school or having never attended school.[24]

The majority of older adults have blood pressure within the normal range (<150/90 mmHg). This is likely due to the nursing home's routine program of exercise for older adults three times a week, regular health checks by doctors every two months, and daily monitoring by nurses that helps keep systemic diseases under control. In addition to conducting examinations, doctors also prescribe antihypertensive medication to help maintain blood pressure within a controlled range. This finding is in line with previous studies showing that regular physical activity and exercise are effective in reducing blood pressure among older adults. In addition, antihypertensive therapy is administered to maintain blood pressure control and should be carefully titrated in older adults to achieve a safe reduction in blood pressure and minimize the risk of adverse effects.[26]

This study also showed that the majority of older adults did not use dentures (Table 1). According to nursing home officials, this is related to a lack of dental and oral health monitoring, as well as low awareness of the importance of replacing missing teeth. A lack of knowledge about the benefits and functions of dentures causes many older adults to not prioritize this need. Previous studies have also reported that reluctance to use dentures is generally influenced by limited education or counseling on dental and oral health.[27]

In addition, the perception that the cost of making and maintaining dentures is high, concerns about discomfort, and the habit of adapting to missing teeth also contribute to the low use of dentures among older adults.[28] In line with the low

use of dentures, most respondents in this study had fewer than 20 remaining teeth (Table 1). This finding is most likely related to caries and periodontal disease, which are known to be the main causes of tooth loss in older adults .[7] Tooth loss can be exacerbated by other factors, such as xerostomia due to the use of medications for systemic diseases, trauma, and suboptimal oral hygiene.[7]

The level of education is thought to play a role in shaping dental and oral hygiene behaviors. Previous studies have reported that the higher the level of education, the better older adults' knowledge of dental and oral hygiene care.[27] The low level of dental and oral health promotion activities among older adults contributes to limited knowledge, attitudes, and behaviors regarding oral hygiene. This condition ultimately leads to low awareness of efforts to improve dental and oral health.[25,27]

Most respondents still had teeth in the anterior mandible, whereas the greatest tooth loss occurred in the anterior maxilla (Table 1). This condition can be attributed to the high risk of trauma to the maxillary anterior teeth because of their more protrusive position, whereas the mandibular anterior teeth are more protected because of the flexible movement of the mandible.[27] In addition to trauma, tooth loss in the maxilla can also be influenced by age, caries, and periodontal disease.[7] These findings indicate a site-specific pattern of tooth loss in this study, with the anterior maxilla being the region most frequently affected.[14]

In this study, the average respondent had good nutritional status (Table 2). This indicates that most older adults were still able to maintain adequate nutritional intake despite being in the aging phase. This condition is likely influenced by the availability of food at the Budi Mulia 2 Cengkareng and Jelambar Nursing Homes, which provide menus with balanced nutritional composition. In addition, older adults are thought to adapt by choosing foods that are easier to chew, such as soft-textured foods or foods cut into small pieces, thereby maintaining adequate nutritional intake. This finding is in line with studies reporting that older adults with chewing difficulties can still meet their nutritional needs by choosing soft foods.[10] According to information provided by the Budi Mulia 2 Cengkareng and Jelambar Nursing Homes, all older adult residents received an additional glass of milk every morning. This may have contributed to maintaining adequate nutritional intake among residents, including those with tooth loss.[10,29]

Most participants did not use dentures. According to information provided by the nursing home staff, this may be related to limited monitoring of oral health and low awareness of the importance of replacing missing teeth with dentures. Nevertheless, most participants had good nutritional status. This finding may be related to the regular provision of nutritionally balanced meals at the nursing homes, as well as food texture modification, such as softer foods or foods cut into smaller pieces, which may have facilitated food intake among participants who did not use dentures.

The provision of an additional glass of milk each morning may also have helped support adequate nutritional intake. However, five of the nine respondents who used dentures experienced poor nutrition status. This indicates that dentures may not fully restore the function of natural teeth, as some older adults still experienced discomfort when chewing certain foods, which ultimately affected their eating patterns.[30]

The majority of respondents also experienced cognitive impairment, which was related to having <20 teeth (Table 2). This finding suggests that a lower number of remaining teeth may be associated with poorer cognitive function in older adults.[31] Tooth loss may impair mastication and reduce oral sensory input to the brain, which could be related to cognitive decline.[32]

Reduced stimulation from periodontal receptors during mastication may affect brain regions involved in memory and cognition, such as the hippocampus, and may also decrease cerebral blood flow. In addition, tooth loss has been associated with chronic inflammatory processes that may contribute to cognitive impairment.[33] In this study, all nine respondents who used dentures had normal cognitive function. This finding reinforces the view that tooth loss should be addressed with prostheses to maintain masticatory, phonetic, aesthetic, and cognitive functions.[32]

Bivariate analysis showed that there was a relationship between the number of teeth and nutritional status among older adults (Table 3). The Spearman correlation coefficient indicated a weak positive correlation between the two variables, suggesting that older adults with a greater number of teeth tended to have better nutritional status. However, the strength of the association was relatively weak, indicating that nutritional status may also be influenced by other factors.

One possible explanation is that most missing teeth were anterior teeth, whereas some posterior teeth, which play a major role in mastication, were still present and able to assist in chewing food. Previous studies have reported that impaired chewing ability and dietary restrictions are more strongly associated with the loss of posterior teeth.[34] In addition, the consumption of soft or easy-to-chew foods, routine intake of milk for older adults, and the use of dentures may help maintain adequate nutritional intake despite tooth loss.

Older adults with fewer than 20 teeth tended to experience a decline in chewing ability, making it more difficult for them to consume hard-textured foods such as meat, fibrous vegetables, fruits, and nuts, which could ultimately limit dietary variety and affect nutritional status.[12]

However, the weak correlation indicates that other factors also play a role, such as the presence of functional posterior teeth, adaptation through choosing soft or easy-to-chew foods, regular consumption of milk provided to the older adults in nursing homes, and the use of dentures, which can support chewing function, although some older adults still experience discomfort, resulting in suboptimal food intake.[14,29] Psychological and systemic aspects such as stress, depression, loneliness, cognitive decline, gastrointestinal or swallowing disorders, limited mobility, and side effects of medications such as nausea and xerostomia can also decrease appetite and nutritional intake, thereby increasing the risk of malnutrition.[35]

In addition to being related to nutritional status, the number of teeth possessed among the older adults in this study was also related to cognitive function (Table 4). The strength of the correlation coefficient obtained was classified as moderate. This may be due to the influence of various factors that can affect cognitive function in older adults, including age, nutritional status, comorbid systemic diseases, educational and sociocultural background, psychosocial conditions, environmental and occupational factors, as well as denture use.

The correlation between the number of teeth and cognitive function was significant, suggesting that tooth loss may interfere with the mastication process, thereby reducing sensory stimulation transmitted to the brain.[17] Optimal chewing function involves complex coordination between the teeth, temporomandibular joint (TMJ), masticatory muscles, blood vessels, and the nervous system.[16]

However, the strength of the correlation obtained was moderate, possibly because nine respondents used dentures to replace their missing natural teeth, thereby relatively maintaining chewing function. All older adult denture users in this study were also recorded as having normal cognitive function. This is in line

with research reporting that individuals who are still able to chew, either with their natural teeth or dentures, tend to have better cognitive function. Thus, replacing missing teeth with dentures is an important strategy for maintaining chewing function and cognitive function in older adults.[32]

There was a significant relationship between the nutritional status of older adults and cognitive function (Table 5). This finding is related to the nature of the central nervous system, which is highly sensitive to reductions in nutrient intake, such that nutritional deficiencies can impair brain function, including cognitive function. Malnutrition is known to accelerate decline in brain function because of nutrient deficiencies, particularly micronutrients such as vitamin B12, folate, omega-3 fatty acids, and iron, which play crucial roles in metabolism and nerve transmission, thereby affecting concentration, memory, and thinking speed. Conversely, excessive nutrient intake or obesity can increase the risk of systemic inflammation and oxidative stress, which negatively affect nerve function.[36–38]

This study has several limitations. First, the respondents were recruited solely from the Budi Mulia 2 Nursing Home (Cengkareng and Jelambar), which may limit the generalizability of the findings to older adults residing in other social institutions or in the community. Second, the cross-sectional design involved simultaneous measurement of the remaining number of teeth, nutritional status, and cognitive function, thereby precluding conclusions regarding causal relationships or changes in nutritional status and cognitive function over time. In addition, this study assessed only the number of remaining teeth and did not evaluate tooth condition or quality. Masticatory ability was also not measured directly, and the quality or functional adequacy of dentures was not assessed. These factors may influence nutritional status and cognitive function and should be considered in future studies.

CONCLUSION

The number of remaining teeth among older adults was significantly associated with nutritional status. Older adults with a higher number of remaining teeth tended to have better nutritional status, possibly because retaining more teeth supports masticatory function and food intake.

The number of remaining teeth was also significantly associated with cognitive function. Older adults with a higher number of remaining teeth tended to have better cognitive function. These findings suggest that maintaining oral health and preventing tooth loss may play an important role in supporting nutritional status and cognitive health among older adults. Therefore, regular dental care, early prevention of tooth loss, and appropriate oral rehabilitation should be considered as part of strategies to promote healthy aging. The implication of this study is that the preservation of natural teeth may play an important role in supporting nutritional status and cognitive function among older adults. These findings suggest that efforts to maintain natural teeth and prevent tooth loss should be considered as part of strategies aimed at promoting healthy aging and improving the overall well-being of the older adult population.

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