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Chewing Difficulty and Diet Quality among Edentulous Elderly: Descriptive Correlation Study

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Abstract
Background: Edentulism is a public oral issue which negatively impacts chewing and diet quality among elderly. **Aim:** Assess chewing ability and diet quality among elderly. **Research design:** Descriptive research design was used. **Setting:** This research was conducted at outpatients' clinics of Qena University Hospitals and outpatients' clinics of removable prosthesis at Faculty of Dentistry, South Valley University. **Sample:** A purposive sample of 250 edentulous elderly. **Tools:** three tools have been used: **Tool (I)** socio-demographic characteristics. **Tool (II):** Chewing Function Questionnaire. **Tool (III):** Diet Quality Index-International. **Results:** The age of elderly participants mean± SD was 67.30 ± 2.34, wearing denture improve chewing ability especially elderly with partial tooth loss and a significant strong negative correlation was found between the chewing problems and diet quality (r = **-0.670**, p = **0.001**). **Conclusion:** Increase chewing difficulties among non-denture wearers edentulous elderly which significantly impact diet quality. **Recommendations:** The current study recommended designing of health education program for elderly about use denture well and improve diet quality.

Keywords: Chewing Ability, Diet quality, Edentulism & Elderly

Introduction
Aging is a crucial phase of human life, and it is essential to address the issues, needs, and diseases associated with this stage. According to the World Health Organization (WHO) in 2021, elderly individuals are those aged 65 and above, and a significant proportion of this population lives in developing countries. As a result of improvements in healthcare and treatment, the global elderly population is growing, leading to what is known as the "demographic revolution." WHO has projected that the global elderly population reached 727 million by 2020, and it is expected to surpass 1.5 billion by 2050 **(Rajati, et al., 2023).** The proportion of Egyptians aged 60 and above are 6.8% of the country's total population. By 2052, it is predicted that this figure would have increased to 17.9% **(Central Agency for Public Mobilization & Statistics 2022).**

Edentulism is a serious health issue, especially for the elderly. The frequency of edentulism varies by country and rises with age. Edentulism is the partial or complete loss of teeth that are permanent. It usually results from periodontal disease and dental caries. This disorder is considered irreversible and is currently being tracked in numerous nations and age groups as an epidemiological measure of oral health **(Yuan, et al., 2020 & Escobar, et al., 2024)**.

Moreover, the proportion of the geriatric population without teeth was 9.5%. This increased with age, with 18.1% of those who aged 80 years being edentulous, with a higher rate of it among female than the male **(Park, et al., 2023)**. as it impacts elderly individuals' ability to chew effectively resulting limiting their food choices to items that are soft and easily masticated (**Satishkumar, et al., 2021).**

Modern trends indicate that edentulism, which is a widely used indicator of oral health and can be easily and reliably recorded, is declining, and tooth loss is occurring later in life. Despite this, impaired chewing ability remains a significant health issue, as evidenced by numerous studies that demonstrate a substantial difference in the number of missing teeth as individuals age. The loss of a specific number of teeth has a profound impact on people's lives, including their masticatory function, nutrition, speech, and aesthetics **(Borg-Bartolo, et al., 2022)**

Elderly who are edentulous tend to avoid consuming hard and coarse foods, such as fruits, vegetables, and meat, which are significant sources of vitamins, minerals, proteins, and fiber. This is due to the fact that these foods are challenging to chew with a complete denture **(Habib, et al., 2020).** Furthermore, those edentulous elderly experience a decrease in their chewing function often find that their diet is impacted **(Bakker, et al., 2021)**. Therefore, diet quality of those people may be affected. Diet quality is essential for maintaining good health and reducing the risk of serious diet-related illnesses like cancer and metabolic syndrome **(Watanabe, et al., 2022).**

Gerontological nurses help to preserve the oral health of the elderly as an integral component of a successful oral hygiene program. Nurses have the expertise and abilities to evaluate the oral health needs of the elderly, create customized care plans, provide dental hygiene services, make recommendations to dentists, and create oral health programs **(Abd Allah, et al, 2020)**

Significance of the study:

According to the US National Health and Nutrition Examination Survey, edentulism was prevalent in 0.7% of the population aged 20–44 years but increased to 20.2% in the geriatric population aged over 65 years **(Lee, 2022).**

dental health issues can impair chewing ability, potentially causing malnutrition. Therefore, edentulous elderly often experience greater chewing difficulty, which can lead to the avoidance of harder foods such as meats, fruits, and vegetables, which are primary sources of essential nutrients like proteins, fiber, minerals, and vitamins which can negatively impact nutritional intake and overall diet quality **(Chauhan, et al., 2024 & Chan, et al., 2023).**

Aim of the study:

The aim of the study was:

1. **The general aim was to:** assess chewing difficulty and diet quality among edentulous elderly.
2. **The specific aim was to:**

- Evaluate chewing difficulty among edentulous elderly.
- Evaluate diet quality among edentulous elderly.
- Shed light on the relation of chewing difficulty and diet quality among edentulous elderly.

Research questions:

1. What is the chewing ability of edentulous elderly?
2. What is the level of diet quality of dentulous elderly?
3. What is the correlation between chewing difficulties and diet quality among dentulous elderly?

Subject and Method:

Research design:

Cross sectional descriptive design was used in this study.

Setting:

The study was conducted at outpatients' clinics including internal medicine clinic, gastroenterology clinic, cardiology clinic, ortho-surgery clinic, rheumatology and rehabilitation clinic, and general surgery clinic at Qena University Hospitals and outpatients' clinics of removable prosthesis at Faculty of Dentistry, South Valley University.

Sample:

Purposive sample of 250 edentulous (partial and complete) elderly both male and female who aged 65 years or above and willing to participate in the study.

Sample size:

The total number of edentulous elderly was 2400 in 2022 and the sample size was calculated by using G.Power with the following parameters; confidence level 0.95, alpha error 0.05, effect size 0.3. The total sample size was 220. in addition to 10% for accuracy, sample size will be 250 edentulous elderly.

Exclusion criteria:

1. Edentulous elderly who have mental or neuromuscular/muscular disorders.
2. Edentulous elderly with permanent tooth implant
3. Elderly Patient with a history of temporomandibular disorders such as myofacial pain dysfunction syndrome (MPDS), trauma and ankylosis were excluded, which these conditions interfere with elderly chewing ability.

Tools of the study:

Three tools were used for data collection**.**

Tool (I): sociodemographic structured interview: by (El-Gilany et al., scale, 2012) it includes sociodemographic data as age, gender, education level, occupation before retirement and residence**)**

Tool (II): Chewing Function Questionnaire (new chewing function questionnaire for assessment of a self-perceived chewing function).

This tool was developed by **Peršić, et al., 2013**. This tool used to assess chewing ability of edentulous elderly and consists of 10 questions: **Q1:** Have any difficulty chewing apples / raw carrots, or foods of similar consistency? **Q2:** Have any difficulty chewing baked or fried firm meat, or foods of similar consistency? **Q3:** Have any difficulties chewing biscuits, crackers, tea biscuits, or foods of similar consistency? **Q4:** Have any difficulty chewing fresh bread, doughnuts or foods of similar consistency? **Q5:** Have any difficulty chewing nuts / walnuts /almonds /peanuts, or similar food? **Q6:** Have any difficulty chewing lettuce, raw cabbage, or similar food? **Q7:** Have you felt insecure when chewing? **Q8:** Have any difficulty when biting different foods (food incision)? **Q9:** Have you noticed food catching or food remaining sticked between dentures or teeth during or after meals? and **Q10:** Have any difficulty chewing chewing gum? The questionnaire scored range from 0 to 4 (5-point Likert scale) with higher scores indicating more severe problems while 0 score represents the absence of any problems or absence of any chewing difficulties.

Tool (III): The Diet Quality Index-International (DQI-I)

The DQI-I was calculated to assess the diet quality according to the method defined by **Kim, et al., 2003.**

The DQI-I focuses on four major aspects of a high-quality diet, i.e., variety, adequacy, moderation and overall balance. Under each of these categories there are specific components of diet to be assessed. **Variety**: Variety in the diet is evaluated in two ways, i.e. **overall variety** and **variety within protein sources**, to assess whether intake comes from diverse sources both across and within food groups. **Adequacy**: this category evaluates the intake of dietary elements that must be supplied sufficiently as a precaution against undernutrition and deficiency disorders. **Moderation:** which evaluates the intake of food and nutrients that are related to chronic diseases and that may need restriction**. Overall balance**: This category examines the overall balance of diet in terms of proportion of energy sources and fatty acid composition. The total DQI-I scores, ranging from 0 to 100 (0 being the poorest and 100 being the highest possible score **(Tur, et al., 2005).**

Tools validity: The content validity of the tool was assured by (3) expertise in gerontological nursing. Every member was contacted and asked to review the tool content and its structural design to ascertain completeness, and clarity of the question items. There were no modifications made to the tools.

Tools reliability: Reliability of tool was carried out using the Cronbach alpha test to confirm its consistency. It was found to be

For tool II Chewing Function Questionnaire (.871)

For tool III The Diet Quality Index-International (.816)

Methods:

Administrative phase: After explanation of the study aim and objectives, an official permission was obtained from the general managers of Qena University hospitals and Dean of Faculty of Dentistry asking for cooperation and permission to conduct the study.

Pilot study: Before the start of data collection, pilot study was performed on 25 of elderly (10%) to examine the applicability, and clarity of the tools. There was no modification needed based on the result of the pilot, so it was not excluded from the study.

Ethical considerations:

Research proposal was approved from ethical committee at Faculty of Nursing at Assiut University on October 22, 2023, under code number 1120230700. The study followed common ethical principles in clinical research. There were no risks for study participants during application of the research. Oral consent was obtained from participants or guidance that is willing to participate in the study after explaining the nature and purpose of the study. Study participants had the right to refuse to participate or withdraw from the study without any rational. Study participant's privacy was considered during collection of data. Confidentiality and anonymity were assured. Ethics, values, culture and beliefs were respected.

Preparatory phase:

Books, journals, the internet, and articles were used to review literature from the past and present that covered every facet pertinent to the processing and design of the study.

Field work:

Data collection of the study was started at the beginning of February 2023 until the end of June 2023. The researcher introduced himself to elderly participants, explained the aim of the study, fill the questionnaire, and ensure their cooperation. Informed consent was obtained from the participants. Interviewing the elderly was carried out in the waiting zone of the outpatients' clinics at Qena University hospitals and outpatients' clinics of removable Prothesis at Faculty of Dentistry. The questionnaire took about 20 minutes to complete. Data was collected at 3 days (Sunday, Monday& Wednesday from 9am to 2pm) every week within 4 months. The researcher took 5 patients each day, 15 patients each week which is about 60 patients per month. The interviewing questionnaire sheet was completed by the researcher from each elderly participant**.**

Statistical design:

Data collected from the studied sample was revised, coded, and entered using personal computer (PC). Computerized data entry and Statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 24. Data were presented using descriptive statistics in the form of frequencies and percentages. Numerical data presented in Mean ± SD. Pearson correlation coefficient measures the strength and direction of the association between numerical variables.

Results:

Table (1): Distribution of the Studied Elderly Subjects According to their Sociodemographic Data at Qena city, 2024. N= 250

Sociodemographic Data	N	%
Gender		
Male	150	60.0
Female	100	40.0
Age	Mean ± SD = 67.30 ± 2.34	
Highest level of education		
Illiterate	16	6.4
Read & write	15	6.0
Primary	31	12.4
Preparatory	51	20.4
Secondary (general & technical of 3 or 5 years)	73	29.2
intermediate (2 years) institutes	56	22.4
University graduate	7	2.8
Postgraduate degree	1	0.4
Occupation		
Non-working/housewife	23	9.2
Unskilled manual worker	15	6.0
Skilled manual worker/farmer	53	21.2
Trades/business	48	19.2
Semi-professional/clerk	109	43.6
Professional	2	0.8
Residence		
Urban slum	2	0.8
Rural	155	62.0
Urban	93	37.2
Sociodemographic score	Mean ± SD = 58.12 ± 10.63	
Total	250	100

Table (2): Distribution of the studied elderly according to their Chewing Function Score and Tooth loss with and without Denture at Qena city, 2024. N= 250

The Chewing Function Questionnaire Score	Min.	Max.	Mean ± SD
Partial tooth loss without denture	20	28	23.66 ± 1.73
Partial tooth loss with denture	17	29	20.49 ± 2.39
Complete tooth loss without denture	24	32	30.89 ± 0.95
Complete tooth loss with denture	22	33	25.72 ± 1.97

Table (3): Distribution of the Studied Elderly According to their Diet Quality and Tooth loss with and without Denture at Qena city, 2024. N= 250

The Diet Quality Index-International	Min.	Max.	Mean ± SD
Partial tooth loss without denture	41	53	42.93 ± 1.78
Partial tooth loss with denture	40	51	44.15 ± 1.59
complete tooth loss without denture	31	44	40.49 ± 2.08
complete tooth loss with denture	37	44	42.64 ± 1.26

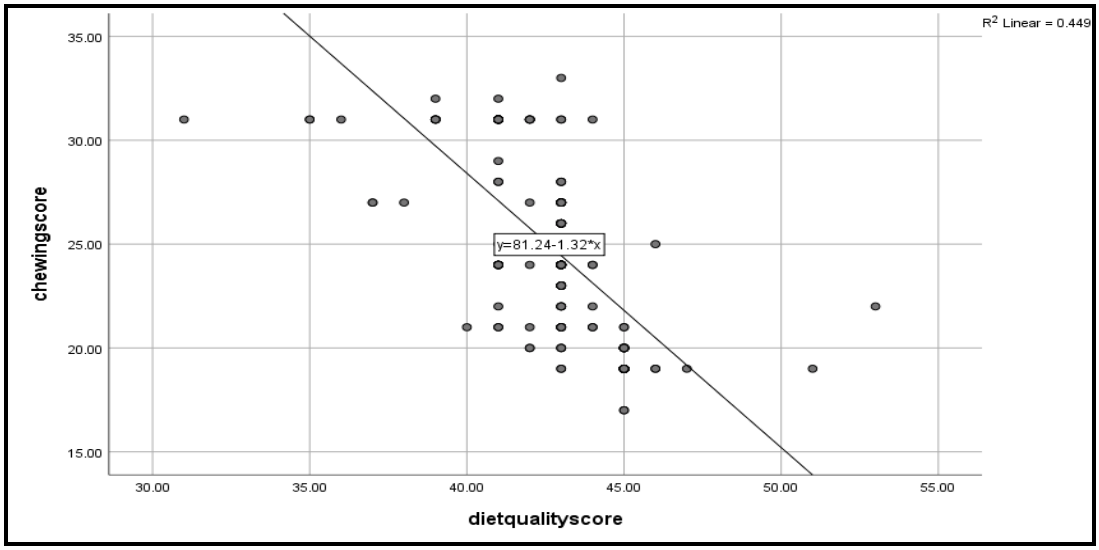

Figure (1): Correlation Between the Studied Elderly subjects' Chewing Function Questionnaire score and The Diet Quality at Qena city, 2024. N= 250

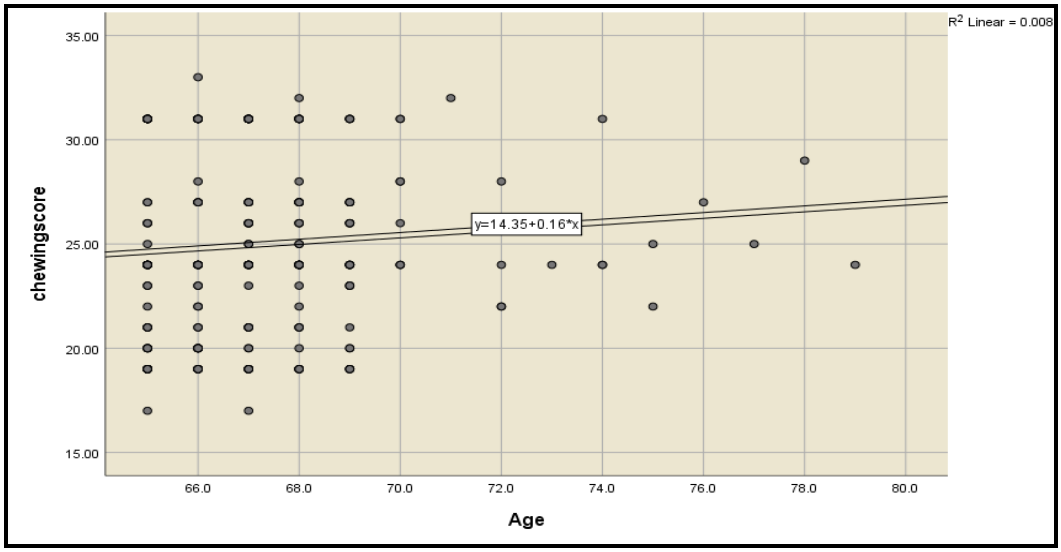

Figure (2): Correlation between the Studied Edentulous Elderly Subjects' Age and Chewing Function Score at Qena City, 2024. N= 250

Table (4): Correlation between the studied Edentulous Elderly Sociodemographic score and Chewing Function Questionnaire Score at Qena City, 2024. N= 250

	Mean ± SD	R	P value
Sociodemographic score	58.12 ± 10.63	- 0.159	0.012*
Chewing Function Questionnaire	24.87± 4.20		

r = Pearson correlation coefficient ** significant level at 0.05*

Table (5): Correlation between the Studied Edentulous Elderly Age and Diet Quality at Qena City, 2024. N= 250

	Mean ± SD	R	P value
Age	67.30 ± 2.34	- 0.177	0.005*
Diet Quality	42.68 ± 2.13		

r = Pearson correlation coefficient ** significant level at 0.05*

Table (6): Correlation between the Studied Elderly Sociodemographic score and Diet Quality at Qena City, 2024. N= 250

	Mean ± SD	R	P value
Sociodemographic score	58.12 ± 10.63	0.537	0.001*
Diet Quality	42.68 ± 2.13		

r = Pearson correlation coefficient ** significant level at 0.05*

Table (1): Shows that the study sample comprised 250 participants, of which 60% were male and 40% were female. The mean age of the participants was 67.3 years, with a standard deviation (SD) of 2.34 years and the majority of them 62% living in rural areas.

Table (2): Summarizes the distribution of the elderly participants based on their chewing function scores with scores categorized according to type of tooth loss and denture wearing. Chewing function scores, the more the chewing score the more chewing problems, varied across four different groups as shown in the table as elderly participants with partial tooth loss without wearing denture the chewing function score range from 20 to 28.

Table (3): Revealed the distribution of the elderly participants diet quality based on type of tooth loss and denture use. The subjects were divided into four groups: partial tooth loss without denture, partial tooth loss with denture, complete tooth loss without denture, and complete tooth loss with denture. The DQI-I score for them with partial tooth loss without denture use is ranged from 41 to 53, with a mean score of 42.93

Figure (1): Illustrates the relationship between chewing function questionnaire score and diet quality. A significant strong negative correlation was found between the chewing function score and diet quality ($r = -0.670$, $p = 0.001$). This correlation was statistically significant at the 0.05 level.

Figure (2): Presents the correlation between the age of the edentulous elderly and their chewing function and clarifies that the mean age of the participants was 67.30 ± 2.34 years. Furthermore, the p-value was 0.169, which is above the commonly accepted threshold of 0.05, suggesting that the correlation is not statistically significant.

Table (4): Displays the correlation between the elderly participants sociodemographic and their chewing function. The table documented the Pearson correlation coefficient (R) between the elderly sociodemographic and their chewing function was -0.159, indicating a strong negative correlation. The p-value was 0.012, which is below the 0.05 significance level, suggesting that the correlation is highly statistically significant.

Table (5): Explores the correlation between the elderly participants age and their diet quality. It is noted that the Pearson correlation coefficient (R) between age and diet quality was -0.177, indicating a negative correlation (p-value 0.005) that suggesting the correlation is statistically significant.

Table (6): Presents the correlation between the elderly participants sociodemographic and their diet quality. This table indicates the Pearson correlation coefficient (R) between the sociodemographic score and diet quality was 0.537 with a moderate positive correlation at p-value 0.001, so the correlation is statistically highly significant.

Discussion

Edentulism is a significant global health issue that contributes to disability worldwide. Moreover, edentulism is closely associated with social disparities, particularly affecting individuals with lower levels of education and income **(Hunter, et al., 2024).** As it can create difficulties in chewing, leading to changes in nutritional intake and malnutrition **(Bakker, et al., 2024)**. Therefore, the aim of the study was to assess chewing difficulties and diet quality among edentulous elderly people at Qena City.

With regard to socio-demographic characteristics, this study showed that nearly two thirds of elderly participants were male and two fifth were female. This finding was supported by **Shammas, et al., 2022** who showed that elderly men had a slightly greater prevalence of overall edentulism than women. From the research point of view, these results may be due to risky behaviors as smoking in male more than female which makes tooth loss more in male than female.

Regarding elderly participants age, the current finding presented the mean age of the elderly participants was 67.30 ± 2.34 years. This result was in agreement with **Eldosoky, et al., 2023** Who showed that the mean age of residents is 68.8 years. Moreover, this result was supported by **Qu, et al., 2024** who showed that the mean age was 66.3 ± 9.2 years. These results might be due to as people age several oral and dental changes with chronic diseases which predispose elderly to tooth loss.

Regarding the chewing ability of edentulous elderly based on the type of tooth loss and denture use, the data indicated that denture use has a significant effect on elderly chewing ability as those participants with partial and complete tooth loss wearing dentures

experienced fewer difficulties in chewing compared to those with partial and complete tooth loss without dentures. These findings were consistent with **Klotz, et al., 2020** who presented that elderly individual wearing suitable removable prostheses demonstrated notably better chewing ability. From the research point of view, denture use among elderly affects their chewing ability as it is associated with selection of food forms.

Data from the literature suggests that more than three quarters of elderly have edentulism which can impact the health of other organs. It is well known that elderly people with dentures or dental pathology limit their intake of fruits and vegetables and consume large quantities of soft foods that are rich in saturated fat and cholesterol which impact diet quality **(Janto, et al., 2022).**

The current findings provided valuable insights into the diet quality of edentulous elderly based on their type of tooth loss and denture use. It demonstrated that the elderly with partial tooth loss without dentures have a moderately poor diet quality compared with the use of dentures which showed a slight improvement in diet quality. Corresponding with **Huraib, et al., 2022** who noted that a significant majority of elderly subjects experienced a considerable rise in their food intake after getting dentures. Prior to receiving dentures, approximately two fifth of participants reported regularly skipping meals. The ability to consume hard foods improved markedly among the subjects, with an increase of two thirds. These results support the use of dentures among partially edentulous elderly improved their food choices and nutrient intake, particularly for harder-to-chew foods.

Concerning the diet quality of the elderly participants with complete tooth loss without dentures exhibited poor diet quality. In this regard, **Hunter, et al., 2024** who examined the relation between edentulism and diet and noted that nutrition was negatively impacted by edentulism.

Interestingly, the elderly group with complete tooth loss with dentures had a mean DQI-I score of 42.64 ± 1.26, indicating that while their diet quality was slightly better than the complete tooth loss without dentures group. This finding consistent with **Moynihan, & Varghese., 2022** who revealed that wearing dentures was positively correlated with nutritional status when compared to not wearing dentures.

Regarding the correlation between the chewing function and diet quality among edentulous elderly participants. The current study finding presented a significant strong negative correlation between chewing function and diet quality suggesting that as the chewing function problems increase, the quality of the diet tends to decrease. These findings supported by **Kotronia, et al., 2021** who observed that complete and partial tooth loss, and periodontal disease were associated with poor diet quality. Also, **Gao, et al., 2025** who presented malnourished elderly exhibit higher chewing function score which indicates poor chewing ability.

Another similar study by **Kim, et al., 2023** showed that chewing difficulty has a shown association with undernutrition. Moreover, **Vasconcelos, et al., 2024** presented a negative association between the chewing function ability and nutritional status among studied edentulous elderly as individual's ability to chew is linked to their dietary choices which can negatively impact a person's nutritional status **(Satishkumar, et al., 2021).** This result suggesting that while decrease mastication muscle tone along with loss of teeth which lead to difficulties in consuming a wide variety of foods, especially those that are hard to chew and result in lower diet quality.

The current data presented, there is no significant relationship between the age of the elderly participants and their chewing function. This indicates that age does not appear to directly influence the elderly participants' chewing function within the sample studied. Conversely, this result was in disagreement with **Özsürekci, et al., (2022)** who presented older adults with diminished masticatory function were found to be generally older in age and exhibited higher levels of frailty.

Regarding the correlation between the sociodemographic score of the elderly participants and their chewing function, the current finding showed that is a statistically significant negative correlation. This suggests that as the sociodemographic score increases, chewing function score tends to decrease slightly and hence a slight increase in chewing ability. This finding was supported by **Bousiou, et al., 2022** who recorded statistically significant correlations with reduced chewing ability were found only for older age and marital status, specifically being widowed as opposed to single. Although not reaching statistical significance, diminished chewing performance was observed in females, individuals with lower educational level, and those who lived alone.

The present results observed that a statistically significant negative correlation was found between the age of the elderly participants and their diet quality. This suggests that as age increases, diet quality tends to decrease slightly. This result comes in line with **Lee, et al., 2021** who showed that as individuals grow older, there is a notable decline in both the consumption of various nutrients and the scores on the Korean Healthy Eating Index (KHEI). Also, a similar study by **De Lucca, et al., 2023** who

presented for each additional year of age, the likelihood of an older adult being at nutritional risk increases by 0.5%. This result might be due to those elderly participants being vulnerable to changes in the gastrointestinal tract, sensory function, and the effects of their chronic diseases which negatively affect the diet quality.

The present result showed a significant positive correlation was the sociodemographic and diet quality of the elderly participants. This result was supported by **Nazri, et al., 2021** who revealed the associated risk factors of poor diet quality of low socioeconomic state elderly which are financial limitations, functional limitations, sex, place of residence, smoking, and oral health. From the research point of view, this result indicates that sociodemographic factors, such as income, education, or living conditions, may have a meaningful impact on the dietary habits and quality of the elderly participants.

Conclusion:

Based on the study results, there was a correlation between chewing difficulty, diet quality, type of tooth loss and type of denture among edentulous elderly. elderly with complete tooth loss exhibited higher chewing difficulty compared to those with partial tooth loss. Additionally, sociodemographic factors were found to significantly influence both chewing function and diet quality of edentulous elderly.

Recommendations:

1. Health education program for elderly about denture and about diet quality.
2. Set strategies based on sustainable development for monitoring oral and dental health issues that integrating the denture function and chewing ability.
3. Dietary and nutritional counseling should be considered for helping the elderly adapt their diet to their chewing capabilities.
4. Conduct further research on improving health-related use of dentures, chewing ability, and diet quality that covers a large number of elderly population and expand as a community-based intervention.

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