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ORIGINAL

The Effect of Denture Wear and Cognitive Nutrition Cookies on Cognitive Function in Pre-elderly in Rural Area of Makassar City

El efecto del uso de dentaduras postizas y las galletas nutricionales cognitivas en la función cognitiva de las personas preancianas en las zonas rurales de la ciudad de Makassar

Elvi[1], A Arsunan Arsin[1], Edy Machmud[2], Anna Khuzaimah[3], Jumraini[3], Indra Fajarwati[4]

[1]Hasanuddin University, Department of Epidemiology, Faculty of Public Health. Makassar. Indonesia.
[2]Hasanuddin University, Prosthodontics Study Program, Department of Dentistry. Makassar. Indonesia.
[3]Hasanuddin University, Department of Nutrition Science, Faculty of Public Health. Makassar. Indonesia.
[4]Hasanuddin University, Department of Health Promotion, Faculty of Public Health. Makassar. Indonesia.

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Corresponding author: A. Arsunan Arsin

ABSTRACT

Introduction: oral health is increasingly recognized as a key factor in overall health, particularly in relation to brain function. Tooth loss has been associated with memory decline through mechanisms such as impaired masticatory function, poor nutritional intake, systemic inflammation, and psychosocial factors. This study aimed to assess the effects of denture wear and cognitive nutrition cookies on cognitive function and depression levels in pre-elderly individuals in rural areas of Makassar City.
Method: this study reviews current scientific literature on the relationship between tooth loss and cognitive impairment. It focuses on studies evaluating biological, nutritional, and psychosocial mechanisms, with special attention to denture therapy and nutritional interventions, particularly fruit consumption.
Results: multiple studies report a significant correlation between tooth loss and increased cognitive decline. Reduced chewing ability affects nutrient intake and may trigger inflammatory responses, both contributing to cognitive risk. Denture therapy has been shown to restore masticatory function and improve nutrition, potentially lowering the risk of cognitive impairment. Additionally, fruit intake provides essential nutrients and bioactive compounds that may support memory and cognitive function.
Conclusion: maintaining oral health through denture therapy, alongside improved nutrition, particularly from fruits, may help preserve cognitive function and reduce the risk of memory decline. Further clinical research is needed to confirm these findings and to develop effective prevention strategies.

Keywords: Tooth Loss; Memory Decline; Cognitive; Denture Therapy.

RESUMEN

Introducción: la salud bucodental se reconoce cada vez más como un factor clave para la salud general, especialmente en relación con la función cerebral. La pérdida de dientes se ha asociado con el deterioro de la memoria a través de mecanismos como la alteración de la función masticatoria, la mala alimentación, la inflamación sistémica y factores psicosociales. El objetivo de este estudio fue evaluar los efectos del uso de dentaduras postizas y las galletas nutricionales cognitivas en la función cognitiva y los niveles de depresión en personas de edad avanzada en zonas rurales de la ciudad de Makassar.

Método: este estudio revisa la literatura científica actual sobre la relación entre la pérdida de dientes y el deterioro cognitivo. Se centra en estudios que evalúan los mecanismos biológicos, nutricionales y psicosociales, con especial atención a la terapia con dentaduras postizas y las intervenciones nutricionales, en particular el consumo de fruta.
Resultados: múltiples estudios informan de una correlación significativa entre la pérdida de dientes y el aumento del deterioro cognitivo. La reducción de la capacidad masticatoria afecta a la ingesta de nutrientes y puede desencadenar respuestas inflamatorias, lo que contribuye al riesgo cognitivo. Se ha demostrado que la terapia con dentaduras postizas restaura la función masticatoria y mejora la nutrición, lo que podría reducir el riesgo de deterioro cognitivo. Además, el consumo de fruta proporciona nutrientes esenciales y compuestos bioactivos que pueden favorecer la memoria y la función cognitiva.
Conclusión: mantener la salud bucodental mediante la terapia con dentaduras postizas, junto con una mejor nutrición, en particular a partir de la fruta, puede ayudar a preservar la función cognitiva y reducir el riesgo de deterioro de la memoria. Se necesitan más investigaciones clínicas para confirmar estos hallazgos y desarrollar estrategias de prevención eficaces.

Palabras clave: Pérdida de Dientes; Deterioro de la Memoria; Cognitivo; Terapia con Dentaduras Postizas.

INTRODUCTION

Dementia is an increasing global health problem. Every three seconds, one person in the world develops dementia. Globally, the number of people with dementia is estimated to reach 46,8 to 50 million, with around 10 million new cases each year.[1] In Indonesia, the number of people with dementia is estimated to reach 1,2 million in 2016 and will increase to 2 million by 2030 and 4 million by 2050.[2] The cost of managing dementia also continues to rise, reaching USD 818 billion in 2016 and projected to reach USD 2 trillion by 2030. Factors contributing to these high costs include a lack of public understanding and limited resources and training for caregivers of people living with dementia.

Based on data from the Ministry of Health (MOH), the prevalence of dementia in Indonesia is 0,2 %. This prevalence is higher in women (approximately 3 %) than in men (around 1 %) and increases with age.[3] The regions with the highest prevalence of dementia in Indonesia are Java and Bali. Biological factors, particularly the hormone estrogen, are thought to play a role in increasing the risk of cognitive impairment in women.[4] Estradiol, one of the hormones in the body, has neuroprotective properties that play a role in limiting oxidative stress damage and protecting nerve cells from amyloid toxicity associated with Alzheimer's.[1]

The prevalence of depression in the elderly is also a global concern that ranges from 8-15 %, while in Indonesia it reaches 76,3 %.[5] Depression that is not treated properly can worsen a person's cognitive function. Social factors, including isolation and lack of social activities, also trigger cognitive decline in the elderly. Therefore, the role of family and health workers is very important in supporting the elderly to remain socially and intellectually active.

One of the risk factors associated with cognitive decline is tooth loss. Several studies have shown that individuals with fewer teeth tend to experience higher cognitive impairment than those with more teeth.[6] This is due to reduced sensory stimulation during chewing, which affects brain activity, especially in the hippocampus which plays a role in learning and memory processes.[7] Studies in rats show that molar tooth loss can affect gene expression in the hippocampus and hypothalamus, which impacts overall brain and cognitive function.[8]

Socioeconomic factors also play a role in a person's cognitive health. People with low economic status tend to have limited access to nutritious foods, including fruits and vegetables that are rich in antioxidants and nutrients essential for brain health.[9] A poor diet due to these economic limitations may contribute to an increased risk of cognitive impairment and dementia. Data from the National Socio-Economic Survey (Susenas) shows that the number of poor people in Makassar City reached 1 388 846 people, with several sub-districts having high poverty rates.[10]

In a preliminary study in Kelurahan Pai, Biringkanaya Sub-district, it was found that the average income of the community is below one million rupiah per month. Most of them work as scavengers and are only able to fulfill their basic food needs, while fruit consumption is not a priority. Fruit is considered an expensive food that is only consumed at certain times, such as when there is a harvest or free distribution. Commonly consumed fruits include bananas, papaya and oranges, which contain vitamins that are good for improving cognitive.[11,12,13]

In addition to fruits, people in the area also have access to two types of vegetables that are easily available and cheap, namely moringa and pumpkin. Both are known to have benefits in improving cognitive function.[14] Unfortunately, fruit and vegetable consumption among the poor often does not meet the standards recommended by the World Health Organization (WHO), which suggests consumption of 150 grams of fruit per day or around

400-600 grams per person per day.[15]

This lack of fruit and vegetable consumption may increase the risk of cognitive impairment. Several studies have shown that consumption of nutritious foods, such as antioxidant-rich vegetables and fruits, may play a role in improving memory and cognitive function.[16] In addition, tooth loss that is not treated properly also contributes to decreased cognitive function. The use of dentures can be one solution to this problem, as they help improve chewing function and increase the intake of nutrients that are important for brain health.[17]

Some studies have also shown that people with tooth loss who do not wear a denture have a higher risk of cognitive impairment than those who wear a.[18] This is because dentures help maintain chewing function, which affects nerve stimulation in the brain.[19] Studies have also shown that there is a link between denture use and increased brain activity, which can be measured through changes in neuroplasticity and brain connectivity using EEG tools.[20]

This intervention is expected to help reduce the incidence of cognitive impairment in poor communities, especially in rural areas such as Makassar City. This program can also be a model that can be applied in various other areas with similar socio-economic conditions. Through a holistic approach that includes dental health and nutrition, it is hoped that the quality of life of the community can improve, and the risk of cognitive impairment can be minimized in the future.

METHOD

This study used a quantitative method with a quasi-experimental approach with a randomized experimental design to measure the effectiveness of education on the use of dentures and nutritional consumption of anti-dementia cookies. The research location was in Biringkanaya District, Makassar City. The research period was from December 2024 to March 2025.

The study employed a quasi-experimental design with a pre-test and multiple post-test approach to evaluate the effectiveness of denture use and cognitive nutrition interventions. The intervention process was structured in four phases: initial measurements (pre-test) were conducted on both the intervention (O1) and control groups (O5). This was followed by an educational intervention (X1 for the intervention group, X2 for the control group). A first post-test was then carried out (O2, O6) to measure immediate outcomes of the education. Subsequently, participants received weekly follow-up assistance (X3 for the intervention group, X4 for the control group), after which follow-up measurements were collected (O3, O7). A final post-test (O4, O8) was conducted after a one-month observation period (Y1, Y2).

The intervention group received comprehensive education and weekly assistance related to denture use, while the control group was provided with education on the consumption of cognitive-supportive cookies without the use of dentures. This study was conducted from August to September 2024 in Biringkanaya District, Makassar City. The population for this study consisted of residents categorized as poor in Biringkanaya District (total population: 214 656 people). Participants were selected using purposive sampling. Inclusion criteria for the main participants were: women aged 50–65 years living in rural areas, listed as poor families (income < Rp. 1 000 000,00), having experienced tooth loss of ≥20 teeth, and willing to actively participate in the intervention. Additional supporting informants—such as family members, local community leaders, and health stakeholders in dental and nutritional fields—were selected based on their relevance, availability, and consent to participate. Sampling was conducted through a door-to-door approach by health workers and local leaders to ensure community engagement and trust.

A total of 25 research subjects were recruited. Data were collected through structured observation forms, interviews, and field notes. All information was digitally recorded and stored using a secure, password-protected database. Regular backups were made on external storage to prevent data loss. Data were coded and processed using SPSS for quantitative analysis and NVivo for qualitative input, ensuring systematic organization and traceability of responses. This design and documentation approach allows for replication of the study in different socio-cultural settings with similar health challenges.

The variables studied using quantitative methods include behavior, which is the respondent's behavior towards denture therapy and nutrition such as moringa, pumpkin, and banana cookies, which is measured through indicators of knowledge, attitude, and action; knowledge, which is the respondent's understanding of denture therapy and nutrition before and after the intervention with indicators of knowing and not knowing; attitude, which reflects the respondent's acceptance or rejection of denture therapy and nutrition based on indicators of agreeing and disagreeing; and action, which measures the respondent's practice in applying denture therapy and consuming nutrition cookies with indicators of doing or not doing these actions before and after the intervention.

Data collection methods in this study include primary data and secondary data. Primary data were obtained through in-depth interviews with respondents to explore their understanding of denture therapy and the provision of anti-dementia cookies on cognitive function, as well as observations made by enumerators to see the pattern of supplementary feeding and document the process in each research area. Meanwhile, secondary

data was obtained from the Social Service in the form of data recap of the poor in Makassar City.

Quality Control in this study was carried out through several steps, namely standardization of measuring instruments by conducting a trial of the questionnaire before use, standardization of intervention tools in the form of education on nutritional consumption of anti-dementia cookies in the form of leaflets, and standardization of enumerators by providing training related to social communities, research instruments, and education to the community to ensure uniform understanding. Each enumerator was also required to sign an Integrity Pact to ensure the relevance and quality of assistance during the study.

Data processing and presentation were carried out through quantitative data processing using JASP software to explain the relationship between variables. The data were then presented in tabular form accompanied by a narrative of the research results, as well as displayed in the form of pictures, charts, diagrams, documents, plans, or sketches relevant to the research. The research instruments used include pre-post questionnaires related to denture therapy and anti-dementia cookie consumption, as well as observation sheets to document findings in the field.

Data validity was tested to ensure its validity and reliability. The validity of qualitative data was tested using source and method triangulation techniques, while quantitative data was tested through the reliability and validity of the questionnaire using the Pearson Product Moment method and the Biserial Correlation Coefficient. Reliability tests were conducted to ensure the instrument provided consistent results using the Cronbach's Alpha coefficient with a value of >0,70.

Data analysis included quantitative analysis conducted using the JASP program. Univariate analysis was used to describe the frequency and percentage distribution of each variable, while bivariate analysis was conducted to compare knowledge and attitude scores before and after the intervention using Repeated ANOVA or Friedman test. Further analysis used General Linear Model or Mann-Whitney to compare two intervention groups, as well as Generalized Estimating Equation to analyze changes in knowledge, attitude, and practice categories between groups.

Research Ethics is applied to protect the rights of respondents, including the right to voluntary participation (Right to Self-Determination), maintaining the privacy and dignity of respondents (Right to Privacy and Dignity), and guaranteeing anonymity and confidentiality of data (Right to Anonymity and Confidentiality). In addition, the research ensures fair treatment for all respondents (Right to Fair Treatment) and considers their physical, psychological and social comfort during the research process (Right to Protection from Discomfort and Harm). This study obtained ethical approval with number. This study obtained ethical approval from faculty of Public Health Commite with number 1609/UN4.14,1/TP.01,02/2024.

RESULTS

Respondent Characteristics This table shows the basic characteristics of the study respondents. The variables shown include age, gender, economic status, and dental health history. Age is expressed as mean and standard deviation as well as minimum and maximum age ranges. Gender, economic status, and dental health history are categorized according to the predetermined classification (table 1).

Table 1. Respondent Characteristics

Variables	Mean ± SD	Min - Max
Age (years)		
Gender (L/P)		
Economic Status (Low/Medium/High)		
Dental Health History (Good/Bad)		

From this table, it can be seen that there was an increase in MMSE scores in both groups after the intervention. The group with dentures experienced an increase in MMSE score from 19,36 ± 3,88 before intervention to 26,84 ± 2,41 after intervention. Whereas in the group without dentures, the MMSE score increased from 18,80 ± 3,73 to 24,60 ± 3,79 (table 2).

Table 2. Comparison of MMSE Scores Before, Mid, and After Intervention

Group	Before Intervention (Mean ± SD)	Mid Intervention (Mean ± SD)	After Intervention (Mean ± SD)
Denture	19,36 ± 3,88	24,72 ± 3,08	26,84 ± 2,41
Without Denture	18,80 ± 3,73	22,88 ± 3,71	24,60 ± 3,79

The mean and standard deviation are used to show the change in depression scores throughout the

intervention period. The table shows that depression levels decreased in both groups after the intervention. The group with dentures showed a decrease in depression scores from 5,16 ± 2,64 before the intervention to 1,68 ± 1,63 after the intervention. Meanwhile, the group without dentures experienced a smaller decrease, from 6,72 ± 1,86 to 5,64 ± 1,68 (table 3).

Table 3. Comparison of Depression Scores Before, Mid, and After Intervention

Group	Before Intervention (Mean ± SD)	Mid Intervention (Mean ± SD)	After Intervention (Mean ± SD)
Denture	5,16 ± 2,64	2,32 ± 2,38	1,68 ± 1,63
No Denture	6,72 ± 1,86	5,72 ± 1,62	5,64 ± 1,68

From the results of the normality test analysis, several variables showed abnormal distribution ($p < 0,05$), so non-parametric statistical tests were performed to test for differences in scores between groups. Friedman test results showed a significant change in MMSE and depression scores in the denture ($p < 0,001$) and no denture ($p < 0,001$) groups. Meanwhile, the Mann-Whitney test showed significant differences between groups at several stages of the intervention, such as in MMSE scores before intervention ($p = 0,011$) and depression scores before intervention ($p < 0,001$) (table 4).

Table 4. Normality Test, Group Difference, and Intergroup Difference

Variables	Normality (Kolmogorov-Smirnov / Shapiro-Wilk)	Friedman (p)	Mann-Whitney (p)
MMSE of Denture Before	0,029 / 0,002	< 0,001	0,011
Mid Denture MMSE	0,000 / 0,004	-	-
MMSE of Denture After	0,007 / 0,011	-	-
MMSE Without Denture Before	0,092 / 0,071	< 0,001	-
MMSE Without Denture After	0,001 / 0,001	-	-
Denture Depression Before	0,046 / 0,149	< 0,001	< 0,001
Denture Depression After	0,003 / 0,000	-	-

DISCUSSION

The results of this study indicate that the use of dentures and the provision of cognitive nutrition biscuits play a significant role in improving cognitive function and reducing depression levels in pre-elderly groups in rural areas of Makassar City. The higher increase in Mini-Mental State Examination (MMSE) scores in the group with dentures compared to the group without dentures emphasizes the importance of dental health interventions in maintaining cognitive function. These results are in line with previous research which states that tooth loss is closely related to decreased brain function due to reduced sensory stimulation during chewing, which plays a role in hippocampal activity as the center of memory and cognition.[4,21]

In addition, the use of dentures contributes to improving chewing function, which indirectly increases the intake of nutrients essential for brain health. In addition to dental interventions, the provision of moringa, pumpkin and banana-based nutritional biscuits has also been shown to have positive effects on cognition. The antioxidant and nutrient content of these ingredients reduces oxidative stress and improves brain neuroplasticity, which contributes to neuronal cell protection and memory improvement.[22,23]

The significant reduction in depression levels in the intervention group suggests that nutritional factors, in addition to playing a role in cognitive function, also have an impact on mental well-being. This is in line with previous studies which found that consumption of foods rich in antioxidants can reduce the risk of cognitive impairment and reduce the prevalence of depression in older people with better nutritional status.[17,24]

In terms of psychological well-being, individuals with tooth loss often experience negative social and emotional impacts that can increase the risk of social isolation and depression. The use of dentures helps restore oral function that not only plays a role in chewing activities but also improves social interaction and self-confidence, which ultimately contributes to lowering depression levels.[25,26] This finding reinforces the results of previous research which states that older people with dentures tend to have a better quality of life than those who experience tooth loss without rehabilitative measures.[27]

Although the results of this study are consistent with previous findings, the main advantage of this study lies in the multidimensional intervention approach that combines oral rehabilitation with nutritional interventions in one integrated study. Unlike previous studies that tend to examine aspects of dental health or nutrition separately, this study shows that the combination of interventions has a more optimal synergistic effect in maintaining and improving cognitive function and mental well-being. In addition, this study focused on people

with low socioeconomic status who have limited access to adequate health and nutrition services. Thus, the results of this study make an important contribution to the development of population-based intervention strategies that can be applied to other vulnerable groups.

However, this study has some limitations that need to be considered. The relatively small sample size limits the generalizability of the results to a wider population. Studies with larger sample sizes may provide more robust and representative results. In addition, the limited duration of the intervention of only one month was not sufficient to assess the long-term effects of denture use and nutritional cookie consumption on cognitive function. Longitudinal studies with longer observations are needed to evaluate the sustained impact of these interventions. Other external factors such as physical activity level, history of chronic diseases, and educational status were also not fully controlled in this study, which could be confounding variables in the results obtained. Therefore, more comprehensive follow-up studies are needed to address these limitations.

The implications of the results of this study suggest that a multidimensional approach that combines dental and nutritional interventions has great potential to improve cognitive health and mental well-being in older adults, especially in areas with limited access to health services. Public health programs should consider providing better access to dentures and education on the importance of nutrition for brain health. In addition, this study can serve as a basis for developing evidence-based policies to prevent cognitive impairment in the elderly population. Further studies with more comprehensive designs, larger samples, and longer intervention periods are needed to strengthen these findings and clarify the mechanisms of the relationship between oral health, nutrition, and cognitive function.

CONCLUSIONS

This study affirms that integrating oral health interventions with cognitive nutritional support is a strategic approach to enhancing cognitive resilience and mental well-being in aging populations, particularly in underserved rural areas.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Elvi, Arsunan Arsin, Edy Machmud.
Data curation: Elvi.
Formal analysis: Elvi, Arsunan Arsin, Jumriani.
Research: Elvi.
Methodology: Elvi, Arsunan Arsin, Anna Khuzaimah.
Project management: Elvi, Arsunan Arsin.
Resources: Elvi, Arsunan Arsin.
Software: Elvi.
Supervision: Arsunan Arsin.
Validation: Elvi.
Display: Elvi, Indra Fajarwti.
Drafting - original draft: Elvi.
Writing - proofreading and editing: Elvi.