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# The effect of protein intake, physical activity and gender on cognitive function in the elderly at Surakarta Health Center

*Pengaruh asupan protein, aktivitas fisik dan jenis kelamin terhadap penurunan fungsi kognitif pada lanjut usia di Puskesmas Surakarta*

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## Abstract

The prevalence of cognitive function impairment increased from 2010 to 2020. Cognitive function declines in the form of memory, language, and action disorders. Cognitive function can be prevented by consuming protein and engaging in physical activity. This study aimed to determine the effect of protein intake on neurotransmitter synthesis, physical activity to increase brain protein, and sex related to metabolism on cognitive function in the elderly at Surakarta Health Center. The research design used observational analytics, with a *cross-sectional* approach. The research location at several health centers namely in Pajang, Jayengan, Gajahan, Sibela and Gambirsari. This study was conducted from January to February 2024. The sample was obtained by *purposive sampling* of 110 elderly people at the Surakarta City Health Center. Research data were obtained through interviews with a protein intake questionnaire (SQFFQ), physical activity questionnaire (IPAQ), and cognitive function questionnaire using the *Mini Mental State Examination* questionnaire, which has been tested for validity and reliability. Data analysis was performed using the Ordinal Logistic Regression Test, with a 95% confidence interval (CI). The results showed that protein intake, physical activity, and sex had no effect on cognitive function (p>0,05). This was due to other factors that were not examined in this study. In conclusion, the decline in cognitive function can be improved by protein intake, which is related to neurotransmitters, and physical activity that is routinely performed can help proteins in the brain increase.

**Keywords:** Cognitive function, gender, physical activity, protein intake

## Abstrak

Prevalensi gangguan fungsi kognitif mengalami peningkatan dari tahun 2010 hingga 2020. Fungsi kognitif yang menurun berupa gangguan daya ingat, bahasa dan tindakan. Fungsi kognitif dapat dicegah dengan konsumsi asupan protein dan aktivitas fisik. Penelitian bertujuan untuk mengetahui pengaruh asupan protein sebagai sintesis neurotrasnmitter, aktivitas fisik untuk meningkatkan protein otak, dan jenis kelamin berkaitan dengan metabolisme terhadap fungsi kognitif pada lanjut usia di UPT Puskesmas Surakarta. Desain penelitian menggunakan analitik observasional dengan pendekatan *cross-sectional*. Lokasi penelitian pada beberapa Puskesmas yaitu di Pajang, Jayengan, Gajahan, Sibela dan Gambirsari. Penelitian dilaksanakan pada bulan Januari-Februari 2024. Sampel diambil secara *purposive sampling* 110 orang lanjut usia di Puskesmas Kota Surakarta. Data penelitian diperoleh melalui wawancara kusioner asupan protein (SQFFQ), aktivitas fisik (IPAQ) dan fungsi kognitif dengan kuesioner *Mini Mental State Examination* yang telah diuji validitas dan reabilitasnya. Analisis data menggunakan Uji Regresi Logistik Ordinal, dengan CI 95%. Hasil, menunjukkan bahwa asupan protein, aktivitas fisik dan jenis kelamin, tidak berpengaruh terhadap fungsi kognitif (p>0,05). Hal tersebut disebabkan oleh faktor-faktor lain yang tidak diteliti dalam penelitian ini. Kesimpulan, penurunan fungsi kognitif dapat ditingkatkan dengan asupan protein yang berkaian dengan neurotransmitter dan aktivitas fisik yang rutin dilakukan dapat menmbantu protein pada otak meningkat.

**Kata Kunci:** Aktivitas fisik, asupan protein, fungsi kognitif, jenis kelamin

## Introduction

According to the World Health Organization (WHO), there are four categories of the elderly: middle-aged 45-59 years old, elderly 60-79 years old, and very old (very old) over 80 years old. The elderly are related to life expectancy in Indonesia; in 2021, it was 10,48%, an increase of 10,82% (Central Statistics Agency, 2021). According to the Ministry of Health of the Republic of Indonesia (2016), the number of elderly people in 2025 is estimated at 23,66 million people or 9,03%, and in 2035, there will be an increase of 28,19 million people. Based on data (Central Statistics Agency, 2021), Central Java City in 2021 had 4,67 million elderly people (12,71%). The number of elderly people in Surakarta City in 2020 was 68,718 or 13,16% (Population and Civil Registration Office, 2020)

According to the Indonesian Ministry of Health in 2016, the elderly experience various changes, such as physical changes and the occurrence of health problems, one of which is a decline in cognitive function. According to the Directorate General of Medical Services of the Ministry of Health of Indonesia in 2010, cognitive function declined in the mild category (Mild Cognitive Impairment) with a prevalence of 32,4% (Noor & Merijanti, 2020). According to the World Health Organization (WHO), in 2013, cognitive dysfunction affected 121 million people, with 5,8% of males and 9,5% of females. Based on data from the Indonesia Psychogeriatric Organization in 2019, elderly aged 50-59 years experience a decline in cognitive function in the form of easy forgetfulness with a light category (Mild Cognitive Impairment) with a prevalence of 39% (Septyani et al., 2023). In Indonesia, the decline in cognitive function in 2005 amounted to 606,100, and in 2020, it increased by 1,016,800 (Amireault et al., 2015). Another supporting research conducted by Fujianur (2018) at the Aisyiyah Nursing Home in Surakarta stated that 10 elderly people experienced a mild decline in cognitive function by 40% and the rest had internal problems with their families, causing the elderly to stay away from their families.

Older adults experience an aging process associated with a decline in neurological function, which is related to the brain's ability to channel signals and communicate (Amarya et al., 2018). The aging process has an impact on physical changes. Physical changes experienced by the elderly include a decline in the nervous system, characterized by a weakening of motor and sensory abilities, which causes a decrease in cognitive function (Pragholapati & Hidayati, 2023). Decline in cognitive function is characterized by impaired memory and orientation of time, space, and place, which are related to limitations in daily physical activity (Henneges et al., 2016). Thus, the decline in cognitive function in the elderly can have an impact on their limited independence in taking care of their own needs; in other words, the burden of relying on others is increasing. In order for the decline in cognitive function in the elderly not to occur drastically, efforts are needed to inhibit the decline, and for that, knowledge is needed about the factors that affect the decline in cognitive function.

According to Masuoka et al. (2021), protein intake affects cognitive function. Another study by Muzamil et al. (2014) showed a relationship between cognitive function and physical activity. Ratnawati (2017) showed that gender influences cognitive functioning. Studies examining the effects of protein intake, physical activity, and sex on cognitive function at the same time have not been conducted. Physical activity is a body movement related to skeletal muscles that produce energy. There are studies that say that physical activity is a modulator that induces structural or functional changes in the brain. Regular physical activity helps inhibit cognitive decline in the elderly by stimulating the brain to improve memory (Erickson et al., 2019).

Food is a nutrient that is consumed so that the body processes it according to its function. The intake of macronutrient foods such as proteins helps protect cognitive function in the elderly (Yeh et al., 2021). Protein intake is necessary for the synthesis of neurotransmitters such as serotonin, which is synthesized from the essential amino acid phenylalanine (Hooshmand et al., 2019). When serotonin levels are low, cognitive function is affected (Siotto et al., 2021). Based on the research conducted by Huang et al. (2023), protein intake from animals can help reduce the risk of cognitive function and brain atrophy.

Novelty in research to analyze research variables that are tested together related to the influence of protein intake, physical activity, and sex on cognitive function in the

elderly. Research on the variables of protein intake, physical activity, and sex that were tested together has never been conducted in the city of Surakarta.

## Methods

This observational analytical study aimed to determine the influence of protein intake, physical activity, and sex on cognitive function in the elderly. This study uses a cross-sectional approach, namely observation and measurement of independent and bound variables, which is carried out at the same time. This study was conducted in February 2024. This study was conducted at the Gajahan Health Center, Gambirsari Health Center, Sibela Health Center, Pajang Health Center, and Jayengan Health Center in Surakarta City.

The number of respondents in this study was determined using the Slovin formula for 110 elderly people from five health centers. There are 17 health centers in Surakarta. The five health centers were considered research locations because the number of elderly people was the largest among the health centers. Purposive sampling was performed. The research groups were divided according to their characteristics and the inclusion criteria. The inclusion criteria for the research subjects were as follows: Elderly 50-59 years old, able to communicate well, four living with family, willing to be respondents, and filling in informed consent. Elderly individuals taking drugs for dementia were excluded from the study.

Data collection in the form of age and gender was recorded on the respondent's identity sheet. Protein intake data were measured using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), using frequency estimates with the number in days, weeks, and months. Protein intake was categorized into three levels: Ough, if >77-119%, less, if <77%; and more, if >12%. Physical activity data were measured using the International Physical Activity Questionnaire (IPAQ), which was conducted by looking at physical activity carried out over the last seven days and categorized into light (IPAQ score < 600 Mets/week), moderate (IPAQ score 600-3000 Mets/week), and heavy (IPAQ score > 3000 METs/week) activities.

The SQFFQ questionnaire can describe the frequency and portion of food then calculated to obtain the total protein intake and compared with the nutritional adequacy number (AKG) so that it is classified in the categories of adequate, less, and over. The IPAQ questionnaire described the time used to perform physical activity and was categorized as low, moderate, or severe. Subsequently, it was calculated as MET per week based on physical activity guidelines. The semi-quantitative food frequency questionnaire (SQFFQ) provides an overview of the number of frequencies and types of intake consumed, and the International Physical Activity Questionnaire (IPAQ) evaluates the type of physical activity level from light to vigorous activity. Both questionnaires are more practical and can be applied to a wider population. The SQFFQ and IPAQ were tested for validity and reliability.

Cognitive function was measured in the elderly using a Mini-Mental State Examination (MMSE) questionnaire consisting of 11 questions including orientation, registration, attention, recall, and language tests. For each question, the lowest score for cognitive function was 1 and the highest score was 5. Cognitive function was categorized as moderately impaired (MMSE score 11-20), mildly impaired (MMSE score 21-26), or not impaired (good) (MMSE score 27-30).

Univariate and multivariate analyses were used for the data analysis. Univariate analysis to describe the characteristics of the study participants. Multivariate analysis was used to test the influence of protein intake, sex, and physical activity on cognitive function. Multivariate analysis was performed using an ordinal logistic regression test with SPSS 26. Statistical significance was set at $p < 0,05$. Assumptions based on ordinal logistic regression analysis are in the form of stratified categories, such as protein intake in categories (less, enough, more). The assumption of relationships between the variables was consistent across all categories.

This research has received a research permit from the Research Ethics Commission of the Faculty of Medicine, Sebelas Maret University. The certificate number from the Research Ethics Commission is 19/UN27.06.11/KEP/EC/2024.

## Result and Discussion

The frequency distribution data of the participants (respondents) characteristics are shown in Table 1. The number of subjects in this study was 110 elderly people with a percentage of 61,8% women and 38,2% men. Based on the calculation of protein intake, respondents in the category of higher intake had the highest percentage (53,6%). The physical activity of respondents with IPAQ scores in the medium category was the highest (53,6%). Regarding cognitive function impairment in respondents, most had an MMSE score in the mild category (49,1%).

**Table 1.** Characteristics of respondents

| Characteristic | | |
|---|---|---|
| Gender | | |
| Man | 42 | 38,2 |
| Woman | 68 | 61,8 |
| Protein Intake | | |
| Enough | 31 | 28,2 |
| Less | 20 | 18,2 |
| More | 59 | 53,6 |
| IPAQ Score | | |
| Light | 42 | 38,2 |
| Keep | 59 | 53,6 |
| Tall | 9 | 8,2 |
| MMSE Score | | |
| No distractions (good) | 18 | 16,4 |
| Mild glitches | 54 | 49,1 |
| Moderate disturbances | 38 | 34,5 |

**Table 2.** The effect of protein intake, physical activity and sex on cognitive function

| Independent Variable | Estimate | p | 95% CI | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Protein Intake | | | | |
| Enough | 0,201 | 0,640 | -0,640 | 1,041 |
| Less | 0,189 | 0,707 | -0,796 | 1,174 |
| Physical Activity | | | | |
| Light | 0,218 | 0,759 | -1,176 | 1,612 |
| Keep | 0,125 | 0,856 | -1,217 | 1,467 |
| Gender | | | | |
| Man | 0,252 | 0,513 | -0,504 | 1,009 |

Based on Table 2, it can be seen that protein intake, physical activity, and gender, respectively, have no significant effect on cognitive function in the elderly with a value of ($p > 0,05$). Based on the confidence interval (CI) value of 0, it can be concluded that protein intake in the adequate category with lower -0,796 and upper 1,174 and protein intake in the lower category with lower -0,796 and upper 1,174 indicate that the estimated parameters measured have no significant relationship between protein intake and cognitive function in the elderly. The lower values of -1,176 and upper values of 1,612 showed that the estimated parameters measured had no significant relationship between physical activity and cognitive function in the elderly. The lower values of -1,217 and upper 1,467 showed that there was no significant relationship between sex and cognitive function in the elderly.

**Table 3.** The simultaneous effect of protein intake, physical activity and sex on cognitive

| Variable | Nagelkerke R square |
|---|---|
| Protein Intake<br>Physical Activity<br>Gender | 0,010 |

Table 3 shows that the Nagelkerke R-squared value is 0,010. This means that protein, physical activity, and sex together (simultaneously) influenced cognitive function by 1 %. Based on the results of this study, most gender data were obtained for women with 68 people (61,8%), with 42 people experiencing mild cognitive impairment and 26 people experiencing moderate cognitive impairment. This research is in line with the research conducted by Akbar & Dainy (2023), who reported that elderly females have a risk of cognitive function impairment of 56,4%. According to Mu'alim & Mufida (2023), women have a higher risk of cognitive function impairment than men because women experience a decrease in estradiol and estrogen hormone disorders related to menopause. Decreased estrogen levels may increase the risk of neurodegenerative diseases that affect brain function (Nisa, 2019).

There was no significant influence of any of the independent variables (protein intake, physical activity, and sex) on cognitive function, and the simultaneous influence of the three independent variables on cognitive function was only 1%, probably because the cognitive

function of the elderly in the study was influenced by other factors that were not studied in this study. In this study, there was no relationship between protein intake, physical activity, and sex on cognitive function. This is due to several factors, such as the method of questionnaire interviews that depend on the respondents' memory in answering the questionnaire. Other factors that were not examined in this study were stress levels, mental state, and family support. Stress factors increase cortisol levels over a long period, causing a decline in cognitive function in the elderly.

Research conducted by Mendonça et al. (2023) revealed an effect between protein intake and physical activity on physical function in adults living in the community. Low protein intake is beneficial in terms of muscle mass related to physical function. Physical activities carried out by the elderly are in the form of walking, cycling. Regular physical activity can improve physical function in the elderly. This research is in line with a previous study Permana et al. (2019), in which the factors that affect the decline in cognitive function were found to be lack of protein intake and low levels of physical activity. Declining health conditions, such as hypertension and diabetes, can accelerate cognitive function decline. Psychological factors such as stress, depression, and anxiety affect cognitive function. Genetic factors, vascular diseases, immune disorders, and history of head trauma can affect cognitive function decline. Other factors such as depression also have a negative impact on the health of the elderly, including a decline in cognitive function. The frequency of depression in the elderly tends to be 20,9% in women and 9,2% in men (Livana et al., 2018).

According to Mardiana and Sugiharto (2022), the decline in cognitive function can be affected by age, gender, educational status, living environment, and economy. Based on research conducted by Riskiana and Mandagi (2021), educational level can affect the decline in cognitive function in the elderly. According to Dalilah (2019), the level of education can cause a decline in cognitive function in the elderly owing to reduced formal and informal stimulation resulting from daily activities. Education can provide stimulation to improve thinking skills and prevent memory decline (Prahasasgita & Lestari 2023).

According to Latifah (2020), occupational factors can affect cognitive function because the elderly who are no longer working will spend time with low physical activity, so they are at a risk of cognitive function decline. Another factor affecting the decline in cognitive function in the elderly is where they live (Mardiana & Sugiharto, 2022). According to Silalahi et al. (2016), mentioned that the elderly who have a place to live with an extended family are related to a decline in cognitive function because the elderly cannot stimulate memory and lack of freedom in doing physical activities. Elderly people tend to be prohibited from engaging in physical activities such as cycling, cleaning housework, and gardening. This has an impact on the stimulation of cognitive functions.

Decreased cognitive function in the elderly causes changes in the nervous system, such as nerve fiber atrophy, resulting in a decrease in motor response and sensory perception in the central nervous system (Pragholapati & Hidayati, 2023). Decreased cognitive function occurs because of neuronal damage caused by high levels of lipid peroxidation, which disrupt the process of transferring information from one synapse to another. Decline in the nervous system leads to mild decline in cognitive function (Mild Cognitive Function) and weight (Widia et al., 2021).

A decline in cognitive function can be anticipated through regular engagement in physical activity and consumption of nutritious food (Hutasuhut et al., 2020). The intake of macronutrients such as proteins, fats, and carbohydrates is the main source of energy. Proteins are amino acid polymers produced from carbon, oxygen, hydrogen, nitrogen, and sulfur. Proteins maintain immunity and form body structures (Małecki et al., 2021). Based on the interview data, the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) found that the majority of respondents consumed plant-based proteins, so they had less impact on cognitive function. Proteins related to cognitive function are animal proteins with a high biological value, such as fish and meat. Research conducted by Gao et al. (2022) reported that plant intake was related to cognitive function. Plant intake can improve skeletal muscle mass. High protein intake is found in grains containing the amino acid lysine, which is associated with decreased cognitive function in the elderly

population. Based on research conducted by Masuoka et al. (2021), high protein intake is found in meat and fish because there are dipeptides with histidine content that protect cognitive functions. Animal protein intake in fish and poultry, if consumed once per week, is more effective in helping cognitive function decline in the future (Qin et al. 2014). Research conducted by Shakersan et al. (2018) found that regular consumption of poultry could prevent a decline in cognitive function in the elderly. Fish and poultry have high protein content related to the prevention of decreased cognitive function. Another study by Coelho-Júnior et al. (2021) reported a relationship between protein intake and cognitive function. The elderly are recommended to consume a high intake of proteins, such as animal protein (meat, fish, eggs, and dairy products), as well as vegetable sources (nuts and seeds). Protein intake is related to the synthesis of amino acids required to produce neurotransmitters, such as serotonin, dopamine, and norepinephrine.

Neurotransmitters can prevent cognitive decline in the elderly. Elderly individuals who regularly perform physical activities can help ward off free radicals in the body. According to Muzamil et al. (2014), physical activity is associated with decreased cognitive functioning. Moderate and low physical activity levels can be associated with impaired cognitive function such as decreased memory and language function. (2020). Seniors can perform physical activities such as aerobic gymnastics because they help improve cognitive function and the volume of the hippocampus, which functions in memory storage.

Regular physical activity affects proteins in the brain and brain-derived neurotrophic factor (BDNF), which maintains nerve cells (Di Liegro et al., 2019). Physical activity can be categorized based on the degree of weight, frequency, duration, and intensity. In this study, the IPAQ was used, which indicated that there was no relationship between physical activity and cognitive function. This study is not in line with the research conducted by Muzamil et al. (2014), who reported a relationship between physical activity and cognitive function. The results of the IPAQ questionnaire in this study were only used to determine the data of low, medium, or high intensity when performing physical activity, so that it does not affect daily cognitive function. According to Sesar et al. (2019), higher levels of physical activity are associated with better cognitive function.

## Conclusion

Based on the data from the results of the study that has been carried out, the variables of protein intake, physical activity and gender together have an influence of 1% on cognitive function in the elderly in the UPT area of the Surakarta City Health Center, while 99% are influenced by other factors that were not studied in this study.

The weak relationship between protein intake variables, physical activity, and calamine type with cognitive function in this study, which was 1%, so that the theme in a similar study can be developed again, and researchers can then consider other factors that affect the decline in cognitive function, such as stress levels or family support.

Researchers can then provide educational programs related to the importance of protein intake and physical activity to prevent decreased cognitive function. In addition, it can develop planned physical activity programs, such as gymnastics classes and the formation of elderly communities, to provide social interaction and motivate a healthy lifestyle in a sustainable manner. It is hoped that there will be an environment that supports the optimal health of each individual.

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## References

Akbar, Z. A., & Dainy, N. C. (2023). Hubungan Status Gizi, Jenis Kelamin, Aktivitas Fisik, dan Asupan Serat Terhadap Fungsi Kognitif pada Pralansia di Kecamatan Cileungsi Kabupaten Bogor. *Muhammadiyah Journal of Geriatric*, *4*(2), 99. https://doi.org/10.24853/mujg.4.2.99-

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Amarya, S., Singh, K., & Sabharwal, M. (2018). Ageing Process and Physiological Changes. *Gerontology*, 3–24. https://doi.org/10.5772/intechopen.76249

Amireault, S., Godin, G., Lacombe, J., & Sabiston, C. M. (2015). The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. *BMC Medical Research Methodology*, *15*(1), 1–11. https://doi.org/10.1186/s12874-015-0045-7

Coelho-Júnior, H. J., Calvani, R., Landi, F., Picca, A., & Marzetti, E. (2021). Protein Intake and Cognitive Function in Older Adults: A Systematic Review and Meta-Analysis. *Nutrition and Metabolic Insights*, *14*. https://doi.org/10.1177/11786388211022373

Di Liegro, C. M., Schiera, G., Proia, P., & Di Liegro, I. (2019). Physical activity and brain health. *Genes*, *10*(9). https://doi.org/10.3390/genes10090720

Dinas Kependudukan dan Pencatatan Sipil. (2020). *Kota Surakarta 2020*.

Erickson, K. I., Hillman, C., Stillman, C. M., Ballard, R. M., Bloodgood, B., Conroy, D. E., Macko, R., Marquez, D. X., Petruzzello, S. J., & Powell, K. E. (2019). Physical Activity, Cognition, and Brain Outcomes: A Review of the 2018 Physical Activity Guidelines. *Medicine and Science in Sports and Exercise*, *51*(6), 1242–1251. https://doi.org/10.1249/MSS.0000000000001936

Gao, R., Yang, Z., Yan, W., Du, W., Zhou, Y., & Zhu, F. (2022). Protein intake from different sources and cognitive decline over 9 years in community-dwelling older adults. *Frontiers in Public Health*, *10*(1), 1–12. https://doi.org/10.3389/fpubh.2022.1016016

Henneges, C., Reed, C., Chen, Y. F., Dell'Agnello, G., & Lebrec, J. (2016). Describing the Sequence of Cognitive Decline in Alzheimer's Disease Patients: Results from an Observational Study. *Journal of Alzheimer's Disease*, *52*(3), 1065–1080. https://doi.org/10.3233/JAD-150852

Hooshmand, B., Refsum, H., Smith, A. D., Kalpouzos, G., Mangialasche, F., Von Arnim, C. A. F., Kåreholt, I., Kivipelto, M., & Fratiglioni, L. (2019). Association of Methionine to Homocysteine Status with Brain Magnetic Resonance Imaging Measures and Risk of Dementia. *JAMA Psychiatry*, *76*(11), 1198–1205. https://doi.org/10.1001/jamapsychiatry.2019.1694

Huang, J., Yu, Y., Li, H., Wei, Y., & Sun, M. (2023). Effect of dietary protein intake on cognitive function in the elderly with chronic kidney disease: analysis of the National Health and Nutrition Examination Survey 2011–2014. *Renal Failure*, *45*(2). https://doi.org/10.1080/0886022X.2023.2294147

Hutasuhut, A. F., Anggraini, M., & Angnesti, R. (2020). Analisis Fungsi Kognitif Pada Lansia Ditinjau Dari Jenis Kelamin, Riwayat Pendidikan, Riwayat Penyakit, Aktivitas Fisik, Aktivitas Kognitif, Dan Keterlibatan Sosial. *Jurnal Psikologi Malahayati*, *2*(1), 60–75. https://doi.org/10.33024/jpm.v2i1.2428

Irfan Permana, Asri Aprilia Rohman, & Tita Rohita. (2019). Faktor Faktor Yang Berhubungan Dengan Penurunan Fungsi Kognitif Pada Lansia. *Bina Generasi : Jurnal Kesehatan*, *11*(1), 55–62. https://doi.org/10.35907/jksbg.v11i1.135

Livana, Susanti, Y., Darwati, L. E., & Anggraeni, R. (2018). Gambaran Tingkat Depresi Lansia. *Jurnal Keperawatan Dan Pemikiran IlMiah*, 80–93.

Małecki, J., Muszyński, S., & Sołowiej, B. G. (2021). Proteins in food systems—bionanomaterials, conventional and unconventional sources, functional properties, and development opportunities. *Polymers*, *13*(15). https://doi.org/10.3390/polym13152506

Mardiana, K., & Sugiharto. (2022). Gambaran fungsi kognitif berdasarkan karakteristik lansia yang tinggal di komunitas Cognitive Functions Based on the Characteristics of Elderly Indwelling-Community. *Jurnal Ilmiah Keperawatan (Scientific Journal of Nursing)*, *8*, 578–583. https://journal.stikespemkabjombang.ac.i

d/index.php/jikep/article/download/1283/822

Masuoka, N., Lei, C., Li, H., & Hisatsune, T. (2021). Influence of imidazole-dipeptides on cognitive status and preservation in elders: A narrative review. *Nutrients*, *13*(2), 1–18. https://doi.org/10.3390/nu13020397

Mendonça, N. M. P., Hengeveld, L. M., Presse, N., Canhão, H., Simonsick, E., Kritchevsky, S. B., Farsijani, S., Gaudreau, P., Jagger, C., & Visser, M. (2023). Protein intake, physical activity and grip strength in European and North American community-dwelling older adults: A pooled analysis of individual participant data from four longitudinal ageing cohorts. *British Journal of Nutrition*, *129*(7), 1221–1231. https://doi.org/10.1017/S0007114522002033

Mu'alim, A., & Mufida. (2023). Faktor-Faktor Yang Berhubungan Dengan Fungsi Intelektual Lansia. *Serambi Akademica: Jurnal Pendidikan, Sains, Dan Humaniora*, *11*(5), 511–520.

Muzamil, M. S., Afriwardi, A., & Martini, R. D. (2014). Hubungan Antara Tingkat Aktivitas Fisik dengan Fungsi Kognitif pada Usila di Kelurahan Jati Kecamatan Padang Timur. *Jurnal Kesehatan Andalas*, *3*(2), 202–205. https://doi.org/10.25077/jka.v3i2.87

Noor, C. A., & Merijanti, L. T. (2020). Hubungan antara aktivitas fisik dengan fungsi kognitif pada lansia. *Jurnal Biomedika Dan Kesehatan*, *3*(1), 8–14. https://doi.org/10.18051/jbiomedkes.2020.v3.8-14

Park, K. S., Ganesh, A. B., Berry, N. T., Mobley, Y. P., Karper, W. B., Labban, J. D., Wahlheim, C. N., Williams, T. M., Wideman, L., & Etnier, J. L. (2020). The effect of physical activity on cognition relative to APOE genotype (PAAD-2): Study protocol for a phase II randomized control trial. *BMC Neurology*, *20*(1), 1–15. https://doi.org/10.1186/s12883-020-01732-1

Pragholapati, A., & Hidayati, E. (2023). Persepsi Caring Mahasiswa Keperawatan. *Jurnal Keperawatan*, *1*(2), 36–41.

Prahasasgita, M. S., & Lestari, M. D. (2023). Stimulasi Fungsi Kognitif Pada Lanjut Usia Di Indonesia: Tinjauan Literatur. *Buletin Psikologi*, *31*(2), 247. https://doi.org/10.22146/buletinpsikologi.80371

Qin, B., Plassman, B. L., Adair, L. S., Edwards, L. J., Popkin, B. M., & Mendez, M. A. (2014). Abstract P185: Fish Intake is Associated with Slower Cognitive Decline in Chinese Older Adults: a Longitudinal Study from the China Health and Nutrition Survey. *Circulation*, *129*(suppl_1), 1579–1585. https://doi.org/10.1161/circ.129.suppl_1.p185

Riskiana, N. E. P. N., & Mandagi, A. M. (2021). Tingkat Pendidikan Dengan Fungsi Kognitif Pada Lansia Dalam Periode Aging Population. *Preventif : Jurnal Kesehatan Masyarakat*, *12*(2), 256. https://doi.org/10.22487/preventif.v12i2.194

Septyani, R., Agustina, D., Achirda, N., Laitupa, A. M., Azzahra, A., Cahyani, I., & Mubarakh, N. Z. (2023). Peningkatan Pengetahuan Fungsi Kognitif Di Posbindu Kenanga Ii Jatimelati Pondok Melati Bekasi. *Jurnal Pengabdian Masyarakat Fisioterapi Dan Kesehatan Indonesia*, *2*(01), 78–87. https://doi.org/10.59946/jpmfki.2023.205

Sesar, D. M., Fakhrurrazy, F., & Panghiyangani, R. (2019). Hubungan Tingkat Aktivitas Fisik dengan Fungsi Kognitif pada Lansia di Panti Sosial Tresna Wredha Kalimantan Selatan. *Mutiara Medika: Jurnal Kedokteran Dan Kesehatan*, *19*(1), 27–31. https://doi.org/10.18196/mm.190125

Silalahi, S. L., Hastono, S. P., & Kridawati, A. (2016). Hubungan Aktivitas Fisik Dengan Fungsi Kognitif Pada Lansia Di Cita Sehat Yogyakarta Tahun 2016. *Jurnal Bidang Ilmu Kesehatan*, *9*(1), 543–552. http://ejournal.urindo.ac.id/index.php/kesehatan/article/view/207

Siotto, M., Germanotta, M., Santoro, M., Cipollini, V., Guardati, G., Papadopoulou, D., Bray, E., Mastrorosa, A., & Aprile, I. (2021). Serotonin levels and cognitive recovery in patients with subacute stroke after rehabilitation treatment. *Brain Sciences*, *11*(5). https://doi.org/10.3390/brainsci11050642

Widia, D. K., Novitasari, D., Sugiharti, R. K., & Sidik Awaludin. (2021). Mini-Mental State Examination Untuk Mengkaji Fungsi Kognitif Lansia Mini-Mental State Examination To Assess Cognitive Function In Elderly. *Jurnal Keperawatan Malang*, *6*(2), 1–13. https://jurnal.stikespantiwaluya.ac.id/index.php/JPW/article/view/137

Yeh, T. S., Yuan, C., Ascherio, A., Rosner, B. A., Willett, W. C., & Blacker, D. (2021). Author response: Long-term dietary flavonoid intake and subjective cognitive decline in US men and women. *Neurology*, *97*(23), 1095. https://doi.org/10.1212/WNL.0000000000012963