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Age, Education, Protein Intake, and Nutritional Status among Indonesian Older Adults: A Population-Based Study

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ABSTRACT

Background: The elderly population in Indonesia has increased rapidly, accompanied by health challenges such as malnutrition, which can lead to sarcopenia and physical weakness. Body weight is one indicator of nutritional status, which can be influenced by characteristics and nutrient intake, such as protein. This study aims to analyze the influence of age, gender, education and protein intake on nutritional status in the elderly in Indonesia.
Subjects and Method: A cross-sectional study of the Indonesian Family Life Survey (IFLS-5) involved 2,908 individuals aged 60 and above. Sociodemographic variables (age, gender, education level, and marital status) were measured using a questionnaire, while protein intake was measured using a Food Frequency Questionnaire (FFQ). Bivariate data analysis was used to determine the relationship between age, gender, and protein intake and nutritional status and logistic regression analysis was used to evaluate factors influencing poor nutritional status.
Results: Age ≥ 71 years (aOR= 2.14; 95%CI= 0.56 to 0.96; p<0.001), male (aOR=1.43; 95%CI= 0.16 to 0.55; p= 0.003) increase the risk of poor nutritional status, while education > Senior High School (aOR=0.22; 95%CI= -0.22 to -0.77; p<0.001), and high protein intake (aOR= 0.80; 95%CI= -0.42 to -0.02; p =0.033) are protective factors for poor nutritional status in the elderly.
Conclusion: Age over 70 years and being male increases the risk of poor nutritional status, while high levels of education and protein intake reduce the risk of poor nutritional status in the elderly in Indonesia.

Keywords: age, education, IFLS-5 protein intake, underweight

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BACKGROUND

The elderly population in Indonesia has been increasing over the past 50 years, in line with global trends (BPS Indonesia 2020). More than 7% of Indonesia's 250 million population is over 60 years old, a percentage that has increased from 5.4% in 1980 (Statistics of Indonesia, 2013). With life expectancy increasing from 67.8 years in 2000-2005 to 73.6 years in 2020-2025

(Statistics of Indonesia 2023), Indonesia faces the dual challenge of an aging population and associated health problems. One of the most significant problems is nutritional deficiencies, which is becoming more common among older adults. Nutritional deficiencies are an important public health problem, especially since Indonesia is ranked 6th in the world for having the largest elderly population (Dewiasty et al. 2022).

The rapid demographic transition in Indonesia is occurring in parallel with an ongoing epidemiological transition, where non-communicable diseases and age-related conditions are becoming increasingly dominant. This shift is reflected in the sharp rise of the elderly population from 9 million in 2010 to around 29 million by 2020, accompanied by a growing burden of NCDs such as hypertension, diabetes, heart disease, and stroke, often coexisting with physical inactivity, obesity, and widespread micronutrient deficiencies (Basrowi *et al.*, 2021; Rukmini Rukmini *et al.*, 2021). Consequently, older adults face heightened risk of complex health issues, particularly malnutrition, which affects 2–15% of community-dwelling elderly and up to 44% in institutional settings, with many more at risk. Unlike acute conditions, nutritional deficiencies develop gradually, frequently overlap with NCD symptoms, and remain underdiagnosed in both clinical and community settings, despite their strong association with frailty, disability, and increased morbidity (Basrowi *et al.*, 2021; Rukmini Rukmini *et al.*, 2021).

Nutritional deficiencies in the form of inadequate protein intake have been linked to conditions such as sarcopenia and risk of falling in the elderly (Volkert et al. 2019). Age, gender, and low protein intake are important factors influencing poor nutritional status in the elderly population (Volpi, Nazemi & Fujita 2004; Keller & Engelhardt 2013; Nowson & O'Connell 2015; Baum, Kim & Wolfe 2016). Studies have shown that lower protein consumption among the elderly in Indonesia is associated with greater muscle loss, which contributes to functional decline (Volpi et al. 2004; Keller & Engelhardt 2013; Nowson & O'Connell 2015; Baum et al. 2016; Volkert et al. 2019).

Protein intake is particularly critical in older adults due to age-related anabolic resistance, a condition in which the body becomes less efficient at utilizing dietary protein for muscle synthesis. As a result, older individuals require higher protein intake—approximately 1.0–1.3 g/kg/day, compared to 0.8 g/kg/day in younger adults—to maintain muscle mass and physical function, with optimal benefits achieved through evenly distributed, protein-rich meals. However, dietary patterns in Indonesia, which are predominantly carbohydrate-based (especially high rice consumption) and constrained by socioeconomic factors, often limit adequate protein intake, particularly from animal sources. Evidence indicates that protein inadequacy affects 40–65% of community-dwelling elderly and up to all individuals in institutional settings. This mismatch between increased physiological needs and insufficient intake creates a structural vulnerability, increasing the risk of sarcopenia, frailty, and complications related to non-communicable diseases (Nowson and O'Connell, 2015; Krisdyana et al., 2021).

Gender differences might also play a role in the pattern of poor nutritional status. Men tend to lose weight more rapidly than women due to differences in muscle mass and metabolic rate. However, women are more susceptible to osteoporosis and bone density loss, especially after menopause, which can complicate the impact of

poor nutritional status (Nowson & O'Connell 2015; Baum et al. 2016; Harbuwono et al. 2018; Nurwanti et al. 2019; Rosiyati & Sartika 2020). Previous studies in Indonesia have not yet linked to poor nutritional status in the elderly to factors such as age, gender, and dietary habits, particularly protein intake. Existing studies suggest that nutritional deficiencies are more prevalent in rural areas and affects men and women differently, but these findings are inconsistent across studies (Oktaviani, Hsu & Chen 2022).

In addition to biological and dietary factors, social determinants such as education level and marital status may influence nutritional outcomes in older adults. Lower educational attainment may limit health literacy, including knowledge of balanced diets and appropriate protein intake, while marital status can affect food access, meal regularity, and social support. Older adults who live alone or are socially isolated may be at higher risk of inadequate dietary intake. Despite these plausible pathways, empirical evidence integrating these sociodemographic and dietary factors within a nationally representative Indonesian dataset remains limited (Arjuna et al., 2017; Dewiasty et al., 2024). This study aims to examine the influence of age, gender, education, and protein intake on poor nutritional status in the elderly population in Indonesia.

SUBJECTS AND METHOD

1. Study Design

All analyses in this study were conducted using secondary data, and no primary data were collected. A cross-sectional approach was applied for data analysis. The data were derived from the fifth wave of the Indonesian Family Life Survey (IFLS-5), which was carried out between 2014 and 2015. IFLS-5 is a nationally representative, population-based longitudinal household survey focusing on socio-economic and health aspects. The survey employed a multi-stage stratified random sampling method across 13 of the 27 provinces in Indonesia, covering approximately 83% of the national population. Ethical approval for the IFLS was obtained from the Institutional Review Board of the RAND Corporation (USA) and Survey Meter (Indonesia), with the ethics clearance number s0064-06-01-CR01. The IFLS-5 dataset is publicly accessible through the RAND website.

2. Population and Sample

The study population consisted of individuals aged 60 years and older. Eligible participants were those with complete data on body mass index (BMI), sociodemographic characteristics, and protein intake. Observations with missing values in key variables were excluded. A total of 2,908 respondents were included in the final analysis.

3. Study Variables

The dependent variable was nutritional status, assessed using BMI. Independent variables included sociodemographic characteristics (age, sex, marital status, and education level) and dietary factor (protein intake).

4. Operational Definition of Variables

Nutritional status was assessed using BMI, calculated as weight in kilograms divided by height in meters squared (kg /m^2). In this study, the outcome of interest was poor nutritional status, defined as underweight (BMI <18.5 kg/m^2). Participants with BMI ≥18.5 kg/m^2, including normal weight, overweight, and obesity categories, were grouped as "not poor nutritional status" for analytical purposes.

Age was categorized into 60–70 years and ≥ 71 years.

Sex was classified as male or female.
Marital status was grouped into married and single/divorced.
Education level was categorized as low (≤ senior high school) and high (> senior high school).
Protein intake was assessed using a Food Frequency Questionnaire (FFQ) and defined based on the frequency of consumption of protein-rich foods (meat, fish, eggs, and milk) Intake was categorized as high if consumed at least once per day and low if less frequent.

5. Study Instruments

Anthropometric measurements, including body weight and height, were collected in IFLS-5 using standardized procedures and used to calculate BMI. Sociodemographic data were obtained through structured questionnaires. Dietary intake was assessed using a semi-quantitative FFQ, which captured the frequency of consumption of selected protein sources.

6. Data analysis

Data were analyzed using descriptive and inferential statistical methods. Observations with missing values in key variables were excluded from the analysis. Descriptive statistics were used to summarize the characteristics of the study population, including frequencies, percentages, means, and standard deviations, as appropriate. Bivariate analyses were conducted to examine the associations between each independent variable and the outcome variable. Variables with a p-value <0.25 in the bivariate analysis were subsequently entered into a multivariable model. Multivariate analysis was performed using a stepwise logistic regression approach to identify independent predictors of the outcome. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Statistical significance was defined as $p < 0.05$. All statistical analyses were carried out using STATA software version 14.0 (StataCorp, College Station, TX, USA).

7. Research Ethics

The IFLS was approved by the Institutional Review Board (IRB) of the Rand Corporation (USA) and the Survey Meter (Indonesia). The ethics clearance number granted by the RAND Human Subjects Protection Committee (RAND IRB) to IFLS5 is s0064-06-01-CR01.

RESULTS

1. Sample Characteristics

Table 1 shows the characteristics of the study respondents. Most respondents were between 60 and 70 years old (70.32%), while only 29.68% were 71 years old or older. In terms of gender, the proportion of women was slightly higher (51.75%) than men (48.25%). Based on marital status, the majority of respondents (64.75%) were married, while 35.25% of respondents stated they were single/divorce.

The education level of most respondents was Senior High School or equivalent (94.39%), and only 5.61% of respondents had an education above Senior High School. In terms of protein intake, more than half of respondents (58.05%) had a low protein intake, while the remaining 41.95% had a high protein intake. Finally, the majority of respondents had not poor nutritional status (BMI ≥18.5) (82.32%), while 17.68% of respondents had poor nutritional status (17.68%).

Table 1. Characteristics of the elderly in Indonesia

Characteristics	n = 2908	%
Age (yr)		
60 – 70	2,045	70.32
≥ 71	863	29.68
Sex		
Female	1,505	51.75
Male	1,403	48.25
Marital Status		
Single/divorce	1,025	35.25
Married	1,883	64.75
Education levels		
≤ Senior High School	2,745	94.39
> Senior High School	163	5.61
Protein Intake		
Low	1,688	58.05
High	1,220	41.95
Nutritional Status		
Not poor (BMI ≥ 18.5)	2,394	82.32
Poor (BMI < 18.5)	514	17.68

2. Bivariate Analysis

Table 2 shows the results of the bivariate analysis, indicating that respondents aged ≥71 years were 2.14 times more likely to have a poor nutritional status (BMI ≤18.5) compared to respondents aged 60-70 years, and this was statistically significant (OR= 2.14; 95% CI: 1.76 to 2.61; p<0.001). Men were 1.34 times more likely to have a poor nutritional status, indicating that men have a higher risk of being underweight, and this was statistically significant (OR= 1.34; 95% CI: 1.11 to 1.62; p= 0.003).

There was no significant association between marital status and nutritional status (OR= 0.90; 95% CI: 0.74 to 1.10; p = 0.317). This indicates that marital status does not affect nutritional status. Respondents with higher education than Senior High School were more likely to have a not poor nutritional status (BMI ≥18.5) compared to respondents with less than Senior High School education and this was statistically significant (OR= 0.23; 95% CI:0.11 to 0.47; p<0.001). This indicates a significant association between education above Senior High School and better weight status compared to those with less than Senior High School education.

Respondents with high protein intake were more likely to have not poor nutritional status than those with low protein intake, and this was statistically significant (OR= 0.80; 95% CI:0.66 to 0.98; p= 0.033). Higher protein intake was associated with better weight status than low protein intake. Age, gender, education, and protein intake were significantly associated with nutritional status. Respondents who were older, male, with lower education levels, and those with lower protein intake were more likely to have a poor nutritional status.

Table 2. Bivariate analysis

Variables	Nutritional Status				OR	95% CI		p
	BMI ≥ 18.5 kg/m²		BMI <18.5 kg/m²			Lower limit	Upper limit	
	n	%	n	%				
Age (Yr)								
60 – 70	1,756	85.87	289	14.13	2.14	1.76	2.61	<0.001
≥ 71	638	73.93	225	26.07				
Sex								
Female	1,270	84.39	235	15.61	1.34	1.11	1.62	0.003
Male	1,124	80.11	279	19.89				
Marital Status								
Single/divorce	834	81.37	191	18.63	0.90	0.74	1.10	0.317
Married	1,560	82.85	323	17.15				
Education levels								
≤ Senior High School	2,239	81.57	506	18.43	0.23	0.11	0.47	<0.001
> Senior High School	155	95.09	8	4.91				
Protein Intake								
Low	1,368	81.04	320	18.96	0.80	0.66	0.98	0.033
High	1,026	84.10	194	15.90				

3. Multivariate Analysis

Table 3 shows the results of a multivariate analysis using backward stepwise logistic regression to evaluate factors influencing nutritional status. Two models are presented: Model 1, which includes all variables, and Model 2, which presents the results after removing insignificant variables. In Model 1, age was significantly associated with nutritional status (AOR= 2.09; 95%CI: 0.54 to 0.94; p<0.001). This indicates that older respondents (≥70 years) were twice as likely to have poor nutritional status compared to younger respondents. Gender was also significant (AOR= 1.54; 95% CI: 0.21-0.66; p<0.001) indicating that men were more likely to have poor nutritional status than women.

Education showed a significant negative association, with respondents with lower education (≤ Senior High School) more likely to have poor nutritional status (aOR= 0.22; 95%CI: -2.21 to -0.77; p<0.001). Marital status was not significant (aOR = 0.84; 95% CI: -0.40 to 0.06; p= 0.153), indicating that marital status had no effect on nutritional status. Protein intake was also significant (aOR = 0.81; 95%CI= -0.41 to -0.01; p= 0.036), indicating that high protein intake was associated with noot poor nutritional status, and low protein intake was associated with poor nutritional status.

Furthermore, in Model 2, after removing the insignificant variable (marital status), the results showed that age remained significant (aOR = 2.14; 95% CI: 0.56 to 0.96; p < 0.001), indicating that older respondents had a higher likelihood of experiencing poor nutritional status. Gender also remained significant (aOR = 1.43; 95% CI: 0.16 to 0.55; p < 0.001), suggesting that males were more likely to have poor nutritional status compared to females. Education remained a strong predictor (aOR = 0.22; 95% CI: -2.22 to -0.77; p < 0.001), indicating that higher education was associated with a lower

likelihood of poor nutritional status. Protein intake was also significant in Model 2 (aOR = 0.80; 95% CI: -0.42 to -0.02; p = 0.032), suggesting that individuals with higher protein intake were less likely to experience poor nutritional status.

Table. 3 Multivariat Analysis with Backward Stepwise Logistic Regression

Model	Independent variables	b	SE	aOR	95% CI		p
					Lower limit	Upper limit	
Model 1	Age ≥ 71 yr	0.74	0.10	2.09	0.54	0.94	<0.001
	Male	0.44	0.11	1.54	0.21	0.66	<0.001
	> Senior Senior High School	-1.49	0.37	0.22	-2.21	-0.77	<0.001
	Married	-0.17	0.12	0.84	-0.40	0.06	0.153
	High Protein Intake	-0.21	0.10	0.81	-0.41	-0.01	0.036
Model 2	Age ≥ 71	0.76	0.10	2.14	0.56	0.96	<0.001
	Male	0.36	0.09	1.43	0.16	0.55	<0.001
	> Senior Senior High School	-1.49	0.37	0.22	-2.22	-0.77	<0.001
	High Protein Intake	-0.22	0.10	0.80	-0.42	-0.02	0.032

b= Logistic regression Coefficient; aOR = Adjusted Odds Ratio; CI = Confidence Interval

DISCUSSION

The results of the multivariate analysis using stepwise logistic regression in this study provide important insights into factors influencing weight loss in the elderly population. This analysis identified age, gender, education, and protein intake as significant predictors of weight loss. The following is an in-depth discussion of each factor and its implications. In this study, overweight and obesity were not analyzed as separate outcomes because the primary focus was undernutrition and low BMI among older adults.

The results showed that older age was significantly associated with the likelihood of having poor nutritional status. Respondents aged ≥71 years indicating that this age group was twice as likely to have poor nutritional status as those younger (aOR= 2.14; 95% CI: 0.56 to 0.96; p < 0.001). These findings align with research showing that aging is often associated with weight and muscle mass loss due to metabolic changes and decreased physical activity (Volpi et al. 2004; Keller & Engelhardt 2013). Sarcopenia, the age-related loss of muscle mass, is a significant contributor to lean body mass decline in older adults. This reduction in muscle mass leads to a lower metabolic rate and decreased energy requirements (Musumeci 2017). In this context, interventions aimed at maintaining muscle mass and adequate nutritional intake among older adults are crucial, especially in the older population. This aligns with research emphasizing the need for targeted nutritional approaches for older adults to prevent malnutrition and low Body Mass Index (Shlisky et al. 2017).

Gender was also found to be a significant predictor in the multivariate model, with men more likely to have a poor nutritional status than women (aOR = 1.43; 95% CI: 0.16 to 0.55; p < 0.001). This confirms that men are at higher risk of being underweight than women. This finding is relevant to previous research showing that men tend to lose muscle mass more rapidly than women with age, which contributes to lower Body Mass Index and poorer nutritional status (Kıskaç et al. 2022).

Older men tend to have more muscle mass and less body fat than women. As they age, muscle mass tends to decrease, while older women generally have more body fat, especially after menopause (Palmer & Jensen 2022). The decline in estrogen after menopause often contributes to increased body fat, particularly in the abdominal area (Fenton 2021). Furthermore, differences in diet and lifestyle between men and women may play a role in these results, with women tending to be more conscious about their nutritional intake (Feraco et al. 2024). Education level was found to be one of the most significant factors influencing nutritional status. Respondents with lower education (≤ high school) having not poor nutritional status compared to those with higher education (aOR= 0.22; 95% CI: -2.22 to -0.77; $p < 0.001$). This indicates that lower education is strongly associated with the likelihood of having poor nutritional status. This finding is consistent with previous research showing that older adults with higher education have better nutrition knowledge and better eating behaviors (Ye et al. 2023). Higher education is often associated with better health behaviors, including a better understanding of nutrition, better access to health services, and adoption of a healthier lifestyle. Respondents with lower education may have limited access to information about the importance of a healthy diet and exercise (Hammouh et al. 2023).

Low protein intake was also found to be a significant risk factor for having poor nutritional status (aOR = 0.80; 95% CI: -0.42 to -0.02; $p = 0.032$). These results are consistent with previous studies that found low protein intake is common in older adults and is associated with reduced muscle strength, physical performance, and bone mineral density (BMD). A study of adults aged 80+ years found that 54% had a low protein intake (<1.0 g/kg/day), which was associated with reduced appetite and eating symptoms (Buhl et al. 2022). Another study reported lower total protein and food-specific protein intake in older adults associated with nutritional status (Nikolov et al. 2021). Low protein intake was associated with lower grip strength and poorer Timed Up-and-Go performance, particularly in women (Granic et al. 2018). These findings highlight the importance of adequate protein intake for maintaining muscle health, physical function, and bone density in older adults. Protein is known as an essential nutrient for maintaining muscle mass and metabolic health (Cruz-Jentoft et al. 2020). Older adults with low protein intake are more susceptible to muscle loss which can lead to a decline in nutritional status.

There are several limitations to this study. First, it was a cross-sectional study using survey methodology, which only included community-dwelling older adults and excluded those in nursing homes. Furthermore, there is potential measurement bias in the determination of nutritional status and protein intake, which were based on self-reports. Therefore, longitudinal studies are needed to better understand the relationship between these factors and nutritional status over the long term.

This study shows that age, gender, education, and protein intake are significant factors in influencing nutritional status in the elderly population. Age over 70 years, low education, and low protein intake can increase the risk of poor nutritional status. Efforts to prevent weight loss in the elderly need to focus on increasing protein intake through nutrition education, especially for elderly with low education. In addition, interventions such as nutritious supplementary food programs and nutritional assistance can be implemented,

especially for elderly over 70 years, to prevent risky weight loss.

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CONFLICT OF INTEREST

All participants were provided informed consent before they were involved in the study.

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