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Research Article

Relationship between Age, Gender, Education Level, Employment Status and Comorbidity with Nutritional Status in Hemodialysis Patients

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ABSTRACT

This research aimed to determine the relationship between age, gender, education level, employment status, and comorbidities with nutritional status in hemodialysis patients. It employed a cross-sectional design. The population consisted of end-stage renal disease outpatients undergoing hemodialysis, totaling 84 respondents aged 19–59 years. The sampling method utilized was simple random sampling. This research was conducted from October to November 2024. Nutritional status was measured using the Subjective Global Assessment (SGA) questionnaire. Statistical tests employed included chi-square and logistic regression analyses. The statistical results indicated a significant relationship between employment status and nutritional status, comorbidity and nutritional status in hemodialysis patients ($p<0.05$). No significant relationships were found between age, gender, and education level with nutritional status among hemodialysis patients ($p>0.05$). The factors associated with nutritional status among hemodialysis patients are comorbidity (OR=6.618; 95% CI:2.124–20.619, $p<0.05$) and employment status (OR=5.887; 95% CI:1.585–21.870, $p<0.05$). Malnutrition is closely related to the presence of comorbidities in hemodialysis patients; therefore, it is crucial to treat and manage comorbidities to prevent the progression of malnutrition in this population. Health workers in the hemodialysis department should pay more attention to the nutritional status of patients who are unemployed.

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INTRODUCTION

End-Stage Renal Disease (ESRD) is a significant public health problem due to the high incidence and prevalence of ESRD patients, which can increase the risk of morbidity and mortality. When kidney function decreases by 10% to 15%, there is a failure to produce urine and perform its filtration function; this requires therapeutic modalities for end-stage ESRD patients, such as hemodialysis therapy (Hameed *et al.* 2024). ESRD patients underwent Haemodialysis (HD) are a population at risk of malnutrition which can increase mortality (Álvarez-García*et al.* 2023). ESRD is a condition characterized by abnormalities in the structure and function of the kidneys that persist for more than three months, significantly impacting health (Cheung *et al.* 2021). The number of new ESRD patients in Indonesia in 2018 was substantial, reaching 66,433 patients, while the number of active patients undergoing HD reached 132,142 (Indonesia Renal Registry 2018). ESRD patients may be at risk of malnutrition, as evidenced by a meta-analysis conducted by Carrero *et al.* (2018), which indicated that the prevalence of malnutrition worldwide among ESRD patients ranges from 11% to 54% (Shengrui *et al.* 2024).

The increasing prevalence of ESRD in Indonesia is attributed to the large number of individuals with Type 2 Diabetes Mellitus (T2DM) and hypertension, which occupy the highest position at 36%. The presence of comorbid diseases in HD patients significantly increases the risk of malnutrition in this population (Murfat *et al.* 2024). Malnutrition in HD patients can be caused by two aspects: iatrogenic factors related to the dialysis process and non-iatrogenic factors, such as financial constraints, low levels of education, and lack of social support (Samsu 2024).

Each session of HD results in a loss of 12 g of amino acids and 8.6 g of protein. If HD patients do not achieve adequate nutritional intake from their food, they will be at a high risk of malnutrition (Lan *et al.* 2024). Nutritional status is not only associated with a decrease in macronutrient intake; several studies have shown that sociodemographic factors, such as income level and educational status, as well as comorbidities, can impact the nutritional status of HD patients. Additionally, HD patients with comorbid Type 2 Diabetes Mellitus (T2DM) often have lower energy intake due to restrictions on carbohydrate consumption, which increases the risk of hypoglycemia. Furthermore, the high potassium content in wheat cereals can elevate the risk of hyperkalemia (Maina *et al.* 2023).

As the incidence and prevalence of T2DM and obesity patients increase, the prevalence of ESRD patients also increases (Ouirdani *et al.* 2024). Additionally, the results of research indicated that male patients and younger patients tend to consume more nutrients due to lifestyle and physical differences, highlighting the need for individualized meal planning (Chen *et al.* 2024). Patients with lower socioeconomic status face barriers in accessing healthcare facilities. Disadvantaged populations often have difficulty purchasing fresh, nutrient-rich foods, which further exacerbates health disparities. Therefore, health equity for patients with lower socioeconomic status, including increased access to healthy food, needs to be considered by policymakers (Chen *et al.* 2024).

Age can affect nutritional status in HD patients, as evidenced by research conducted by Ghorbani *et al.* (2020). Older patients are at a higher risk of malnutrition than younger patients due to factors such as decreased mobility, diminished cognitive function, reduced appetite, difficulties in purchasing food, and poor dental and oral health. The Subjective Global Assessment (SGA) is a practical, non-invasive method that does not require significant costs and is frequently used in clinical practice. The SGA assessment is a valid examination for measuring nutritional status in HD patients (Dai *et al.* 2017). Sociodemographic factors, such as education level, are related to a person's ability to achieve good health literacy, access healthcare facilities, and employment status, which is linked to household income for purchasing diverse and quality food. These factors significantly impact the nutritional status of hemodialysis patients (Imanishi *et al.* 2017). Given that existing research on sociodemographic factors affecting the nutritional status of hemodialysis patients is still limited, the researchers aim to conduct a study based on these variables. This research seeks to determine the relationship between age, gender, education, and comorbidities with nutritional status in hemodialysis patients.

METHODS

Design, location, and time

This quantitative study employed a cross-sectional design. It was conducted from October 13 to November 31, 2024, at Dr. H. Abdul Moeloek Regional Hospital in Lampung Province. The study received ethical approval under Number 374/KEPK – RSUDAM/X/2024.

Sampling

The population in this research consisted of end-stage renal disease patients undergoing hemodialysis. The sampling method employed was a probability sampling method using simple random sampling. The sample size for this research was 84 respondents, calculated using the Lemeshow formula with a precision (d) of 10%, a proportion (p) of malnutrition in Haemodialysis (HD) patients at 72%, and Zα/2 1.96.

The inclusion criteria for this research were as follows: patients aged between 19 and 59 years, undergoing routine HD twice a week, in a stable condition (i.e., not experiencing decreased consciousness, shortness of breath, severe nausea, or vomiting), not pregnant, and free from tuberculosis, hepatitis B, hepatitis C, and HIV infections. Additionally, patients needed to be cooperative during the study.

This research examined comorbidities among HD patients that affect nutritional status. Comorbidity refers to a condition in which a patient suffers from two or more diseases simultaneously. The comorbidities associated with nutritional status include diabetes, congestive heart failure, hernia, pneumonia, peritonitis, ulcerative colitis, cancer, and diarrhea.

Data collection

The data collected through interviews with HD patients and their companions included age, gender, education level, employment status, and comorbidities. Nutritional status assessment in patients was conducted using the SGA questionnaire, comprising six components: the presence or absence of weight change within the past six months, changes in food intake, gastrointestinal symptoms such as nausea, vomiting, diarrhea, and anorexia, assessment of functional capacity, presence of comorbidities and their relationship to nutritional needs, and physical examination (including loss of subcutaneous fat in the triceps and biceps, loss of muscle mass in the clavicle, scapula/ribs, calf, and shoulder, as well as edema and ascites assessment). Patients were assigned a score based on the reviewed results, and the SGA score indicates the patient's nutritional status. The SGA score includes three categories: well-nourished if the A score is ≥50% of the category, classified as malnutrition if the number of B scores is ≥50% of the category, or if the C score is ≥50% of the category, accompanied by the presence of obvious physical signs of malnutrition, such as muscle wasting, edema, ascites, and subcutaneous fat loss (MoH RI 2014; Lestari *et al.* 2023).

The age variables were classified following the standard from the Ministry of Health Republic of Indonesia (MoH RI 2009), as follows: 19–44 years (adult) and 45–59 years (pre-elderly). Gender is categorized as male and female, educational levels are classified as low (elementary to senior high school) and high (undergraduate), employment status is divided into employed and retired, and comorbidities are categorized as with comorbidity and without comorbidity.

Data analysis

Data analysis were conducted using the Statistical Package for the Social Sciences (SPSS) software, version 26.0 for Windows. The obtained data were tested using the chi-square test to determine the relationship between age, gender, education level, employment status, and comorbidities with nutritional status in HD patients.

Logistic regression used the enter method by analyzing variables that were candidates for multivariate selection with a $p<0.25$. However, variables with a $p>0.25$ that were deemed substantially important for nutritional status of HD patients could also be included in the multivariate analysis, such as gender and education level. The highest OR value indicated a stronger effect of the independent variable on the nutritional status.

RESULTS AND DISCUSSION

The majority of hemodialysis HD patients are in the age range of 45–59 years, accounting for 65%, with a majority being male at 51.2%. The education level of HD patients is predominantly low, at 79.8%, many HD patients are no longer employed (64.3%). Additionally, 51.2% of HD patients do not have comorbidities (Table 1). The chronic kidney failure is primarily attributed to excessive consumption of energy drinks and carbonated beverages, while 48.8% of HD patients have comorbid conditions, with hypertension and diabetes mellitus being the most prevalent. Based on the SGA examination to assess nutritional status in HD patients, the largest percentage is classified as well-nourished, at 54.8%.

End-Stage Renal Disease (ESRD) can occur at any age due to various causes. Anatomically, the growth ability of kidney cells decreases, and kidney function declines with age, particularly in older adults and the elderly. With increasing age, there is a progressive decline in the Glomerular Filtration Rate (GFR) and tubular function, reaching a reduction of up to 50% by the age of 70 years. The prevalence of ESRD is greater in male patients than in female patients, as female hormones, particularly estrogen, have protective effects on the kidneys by promoting high levels of endothelial nitric oxide synthase, which exhibits antiapoptotic and antifibrotic effects (Hayati *et al.* 2021). This research aligns with findings from Sultan *et al.* (2021), which indicate that HD patients are more commonly male (65.1%) compared to female (34.9%).

The level of education among HD patients in this research was relatively low. An adequate

Table 1. Univariate analysis of variables affecting nutritional status in hemodialysis patients

Variables (n=84)	n (%)
Age	
19–44 years	29 (34.0)
45–59 years	55 (65.0)
Gender	
Man	43 (51.2)
Woman	41 (48.8)
Level of education	
Low (Elementary – Senior high school)	59 (82.1)
Higher (Undergraduate)	15 (17.9)
Employment status	
Unemployed	54 (64.3)
Employed	30 (35.7)
Comorbidities	
With comorbidities	41 (48.8)
Without comorbidities	43 (51.2)
Nutritional status (SGA)	
Malnutrition	38 (45.2)
Well nourished	46 (54.8)

SGA: Subjective Global Assessment

understanding of the nutritional value of food and proper dietary guidance was limited, which is essential for achieving optimal nutritional fulfillment. The limited educational background of patients could hinder their ability to comprehend the information provided. Therefore, education from healthcare professionals in the HD department regarding nutritional care for HD patients is critically needed (Kutbi *et al.* 2021).

Unhealthy lifestyles, such as smoking, which is more prevalent among men, contribute to the high incidence of ESRD in this population (Sleiman *et al.* 2023). The results of this study indicate that respondents were more likely to have low educational status, with education levels ranging from elementary to high school. Low educational status can increase the risk of developing ESRD by 1.5 times, and it can also accelerate progression and mortality in HD patients (Morton *et al.* 2016). Another finding in this research was that many HD patients were unemployed, as they faced various challenges in maintaining a balance between medical, psychological, and social conditions, along with a lack of support from their work environment, which contributed to many quitting their jobs (Choi *et al.* 2024).

As Table 2 indicates, there is no significant relationship between age and nutritional status in HD patients, with p=0.861. This indicates that, across all age groups, when HD patients have adequate macronutrient intake, it serves as a protective factor against malnutrition (Lan *et al.* 2024). This result contradicts the research by Shengrui *et al.* (2024), which found that older HD patients have a higher susceptibility to malnutrition compared to younger age groups due to factors such as dementia, tooth loss, and deteriorated taste perception. This research aligns with the findings of Bramania *et al.* (2021) involving 160 HD patients at Tanzania Hospital, which indicated no relationship between age and nutritional status in HD patients, with p=0.56. The results of this research align with meta-analytic studies indicating a significant relationship between comorbidity and nutritional status in HD patients, with p=0.04 and OR=1.78. Patients with T2DM, nephropathy, and inadequate glycemic control tend to have reduced food intake compared to those without comorbidities, placing them at a higher risk of malnutrition (Shengrui *et al.* 2024).

The results of this research are not consistent with the findings of Omari *et al.* (2019), which indicated a relationship between age and nutritional status in HD patients, with p=0.010. This discrepancy may be attributed to the fact that as age increases, HD patients often experience decreased mobility, diminished cognitive function, loss of appetite, reduced taste sensation, poor dental and oral health, and difficulties in purchasing and preparing food. Consequently, older HD patients are more susceptible to declines in nutritional status compared to their younger counterparts.

Based on Table 2, there is no significant relationship between gender and nutritional status in HD patients, with p=1.000. This finding is consistent with the research conducted by Nasution (2024), which also reported no relationship between gender and nutritional status among HD patients, with p=0.645. Nutritional status is more significantly influenced by knowledge regarding energy and protein intake; when HD patients experience deficiencies in energy and protein

Table 2. Bivariate analysis of age, gender and educational status variables affecting nutritional status in hemodialysis patients

Variables	Nutritional status (SGA)		Total	*p*	OR 95% CI
	Malnutrition	Well Nourished			
	n (%)	n (%)	n (%)		
Age					
19–44 years	14 (48.3)	15 (51.7)	100.0		1.000
45–59 years	24 (43.6)	31 (56.4)	100.0	0.667	1.220 (0.492–3.023)
Gender					
Woman	19 (46.3)	22 (53.7)	100.0		1.000
Man	19 (44.2)	24 (55.8)	100.0	0.821	0.905 (0.382–2.144)
Education Status					
Lower (Elementary–Senior high school)	31 (44.9)	38 (55.1)	100.0		1.000
Higher (Undergraduate)	7 (46.7)	8 (53.8)	100.0	0.873	0.912 (0.296–2.809)
Employment Status					
Employed	8 (26.7)	22 (73.3)	100.0		1.000
Unemployed	30 (55.6)	24 (44.4)	100.0	0.020*	3.438 (1.300–9.077)
Comorbidities					
Without comorbidities	12 (27.9)	31 (72.1	100.0		1.000
With comorbidites	26 (63.4)	15 (36.3)	100.0	0.002*	4.478 (1.783–11.245)

SGA: Subjective Global Assessment; OR: Odds Ratio; Significant value at p>0.25 based on logistic regression test

intake, they become increasingly susceptible to developing malnutrition (MoH RI 2023). The highest levels of myostatin are found in skeletal muscles, and these levels are influenced by factors such as gender and age. Elevated myostatin levels in the blood serve as a negative indicator of a person's strength and muscle mass deterioration (Ishida & Kato 2023). Female HD patients tend to experience a worse quality of life than their male counterparts due to limitations in accessing and selecting food, a tendency to have more children, the influence of local culture and society, and the challenges of deciding whether to continue working given their health conditions. These factors contribute to a higher risk of malnutrition among female HD patients (Togay & Akyüz 2023).

The results of this research align with the findings of Omari *et al.* (2019), which indicated that HD patients are generally male, comprising 52.3% compared to 47.7% female patients. Additionally, there was no relationship between gender and nutritional status in HD patients, with p=0.639. This research is also consistent with the study by Bramania *et al.* (2021) involving 160 HD patients at Tanzania Hospital, which found no significant relationship between gender and nutritional status in HD patients, with p=0.29.

Data in Table 2 indicate that there is no significant relationship between educational status and nutritional status in HD patients, with p=0.917. This finding contradicts the research conducted by Sharin *et al.* (2019), which suggested that hemodialysis patients with a higher level of education tend to have a better quality of life, characterized by normal nutritional status. This improvement is attributed to greater economic opportunities and access to information. Furthermore, a higher level of education can enhance compliance with dietary and treatment regimens.

The results of this research align with the findings of Omari *et al.* (2019), which indicated that the majority of HD patients have low education levels, at 36.2%. Additionally, there is no relationship between education levels and

nutritional status in HD patients, with p=0.140. Another consistent study is that of Bramania *et al.* (2021), which involved 160 HD patients at Tanzania Hospital and found no significant relationship between education levels and nutritional status in HD patients, with p=0.330.

Based on Table 2, there is a significant relationship between employment status and nutritional status in HD patients, with p=0.020. The OR obtained was 3.438, indicating that HD patients who are not working are at a threefold higher risk of malnutrition compared to those who are still employed. The results of this research align with the findings of Lan *et al.* (2024), which involved 76 HD patients at the Vietnam Hemodialysis Center and also reported a significant relationship between employment status and nutritional status, with p=0.002. This is attributed to the fact that patients who are not working or unable to work often reflect limited functional abilities, making them more susceptible to malnutrition compared to HD patients who retain functional abilities that do not require ambulation training. Another parallel study is that of Azzeh *et al.* (2022), which examined 302 HD patients in Saudi Arabia and found a relationship between employment status and nutritional status, with p=0.038 and an OR=2.257. This means that HD patients who are not working have a 2.257 times higher risk of experiencing malnutrition compared to those who are still employed. This increased risk is due to the financial decline associated with unemployment, which results in reduced purchasing power for nutritious food with high biological value, delayed treatment, and lower health benefits. Additionally, individuals who work tend to enjoy better physical and mental health than their unemployed counterparts, owing to higher mobility and more frequent social interactions.

This research is not consistent with the findings of Bramania *et al.* (2021), which indicated no relationship between employment status and nutritional status, with p=0.33. However, the percentage of HD patients who retired due to ESRD was 73.8%, which is higher than that of HD patients who are still working. The analysis presented in Table 2 shows a significant relationship between comorbidities and nutritional status in HD patients, with p=0.002. The OR obtained was 4.478, indicating that HD patients with comorbidities are at a fourfold higher risk of malnutrition compared to those without comorbidities. These results align with the research of Omari *et al.* (2019), which also found a significant relationship between comorbidities and nutritional status in HD patients, with a p=0.04 and an OR=1.78. This increased risk is attributed to the tendency of HD patients with Diabetes Mellitus (DM) to reduce their food intake compared to those without comorbidities, thereby increasing their risk of malnutrition. Furthermore, the findings are consistent with the research of Caruana *et al.* (2022), which identified significant relationships between the type of open wound comorbidity (p=0.02) and trauma (p=0.004) with nutritional status in HD patients. Comorbidities can adversely affect nutritional status by increasing the rate of catabolism in the body and reducing nutrient intake, leading to diminished energy reserves (Hafi *et al.* 2021).

Another study by Maina *et al.* (2023) revealed that the presence of comorbid diseases in HD patients, such as esophageal cancer, can lead to dysphagia, resulting in difficulties with swallowing that impact the incidence of malnutrition. Hemodialysis patients with comorbidities such as coronary heart disease and type 2 diabetes tend to exhibit elevated inflammatory biomarkers, such as C-Reactive Protein, which can increase the risk of malnutrition and blood vessel blockages, thereby heightening the risk of mortality (Grzywacz *et al.* 2023). The results of this research are not consistent with the findings of Bramania *et al.* (2021), which indicated no relationship between hypertension and nutritional status in HD patients (p=0.78) and no relationship between diabetes mellitus and nutritional status (p=0.12).

HD patients with diabetes mellitus tend to limit their carbohydrate intake, which can increase the risk of deterioration in nutritional status and elevate the risk of hypoglycemia. Additionally, carbohydrate intake from wheat cereals, used as a substitute for rice, has a high potassium content; when consumed excessively, it can increase the risk of hyperkalemia (Maina *et al.* 2023). Other inconsistent studies indicate that there is no relationship between comorbidities such as diabetes mellitus and hypertension with nutritional status in HD patients of both genders, with p>0.05. This lack of association may be attributed to patients' effective adaptation to regularly taking treatment for their comorbid

diseases and their adequate macronutrient intake in accordance with recommended guidelines, thereby preventing the incidence of malnutrition (Satti *et al.* 2021).

Table 3 shows that the results of the statistical analysis from logistic regression modeling indicate that the most dominant variable influencing nutritional status in HD patients is the comorbidity variable, with an OR=6.618. This means that HD patients with comorbidities are at a 6.618 times higher risk of experiencing malnutrition compared to those without comorbidities. The results of this research align with the findings of Grzywacz *et al.* (2023), which stated that HD patients with Type 2 Diabetes Mellitus (T2DM) are at a higher risk of malnutrition than those without T2DM. Additionally, HD patients with T2DM experience higher oxidative stress, mitochondrial dysfunction, and lower glucose uptake, which can lead to metabolic stress and increase the risk of malnutrition (Eldehni *et al.* 2022; Salom *et al.* 2023). Furthermore, cancer can contribute to a decline in nutritional status by increasing protein catabolism, enhancing muscle breakdown, promoting lipolysis and gluconeogenesis, and creating an imbalance between nutrient intake and metabolism, all of which can affect malnutrition among HD patients (Berger *et al.* 2024).

HD patients with T2DM also tend to reduce their carbohydrate intake due to concerns about increasing blood sugar levels; however, excessive reduction in carbohydrate intake can elevate the risk of hypoglycemia (Maina *et al.* 2023). HD patients with comorbidities should pay close attention to their nutritional status due to the high risk of malnutrition, which can significantly impact morbidity and mortality. A limitation of this research is the absence of the dialysis vintage variable, which may influence nutritional status among HD patients. Each HD session results in the loss of 4–9 g of amino acids from the dialyzer, potentially leading to malnutrition if protein intake is inadequate (Lan *et al.* 2024).

CONCLUSION

There is a significant relationship between comorbidity and employment status with nutritional status. However, there is no significant relationship between age, gender, and educational

Table 3. Multivariate analysis affecting nutritional status of hemodialysis patients

Variables	Malnutrition n (%)	Well nourished n (%)	Mulltiple regression (aOR 95% CI)	*p*
Age				
19–44 years	14 (48.3)	15 (51.7)	1.000	
45–59 years	24 (43.6)	31 (56.4)	2.251 (0.742–6.825)	0.152
Gender				
Man	19 (46.3)	22 (53.7)	1.000	
Woman	19 (44.2)	41 (13.8)	1.251 (0.427–3.663)	0.683
Education Status				
Lower (Elementary–Senior high school)	7 (46.7)	8 (53.8)	1.000	
Higher (Undergraduate)	31 (44.9)	38 (55.1)	0.655 (0.154–2.797)	0.568
Employment Status				
Employed	30 (55.6)	24 (44.4)	1.000	
Unemployed	8 (26.7)	22 (73.3)	5.887 (1.585–21.870)	0.008*
Comorbidities				
Without comorbidities	26 (63.4)	15 (36.3)	1.000	
With comorbidites	12 (27.9)	31 (72.1)	6.618 (2.124–20.619)	0.001*

aOR: adjusted Odds Ratio; CI: Confidence Interval; Significant value at p>0.25 based on logistic regression test

status in HD patients at the Hemodialysis Installation at Dr. H. Abdul Moeloek Hospital, Lampung Province. Logistic regression modeling showed he most dominant variable influencing nutritional status is comorbidity. Hemodialysis patients with comorbidities need to pay closer attention to their nutritional status, as they are at risk of malnutrition due to impaired energy and protein metabolism and hypercatabolism resulting from chronic inflammation.

It is recommended that healthcare workers in HD units use alternative nutritional assessments, such as the Subjective Global Assessment (SGA), every six months. This approach will enable the timely identification of patients at risk of developing malnutrition, allowing for immediate nutritional interventions. Additionally, patients with comorbidities should manage and treat their conditions to prevent malnutrition.

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DECLARATION OF CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest from the beginning to the end of the research.

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