



ASSOCIATION NUTRITIONAL STATUS WITH SARCOPENIA AND HYPERTENSION AMONG ADULT IN SEMARANG

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ABSTRACT

Sarcopenia and hypertension are two health conditions that frequently occur in the elderly population. Sarcopenia is characterised by a gradual decline in muscle mass and strength, while hypertension is a major risk factor for cardiovascular disease. Both conditions are influenced by various factors, including nutritional status. This study aims to determine the relationship between nutritional status and the development of sarcopenia and hypertension in the elderly population. The research method used an analytical observational study with a cross-sectional approach conducted at Pegandan and Bululor health centres. Data were collected through anthropometric measurements, nutritional status, physical activity, stress level and blood pressure. The results showed an association between obese nutritional status and increased risk of sarcopenia and hypertension in the elderly population. The conclusion of this study emphasises the importance of early detection and appropriate intervention in addressing sarcopenia and hypertension to improve quality of life and overall health in the elderly population.

Keywords: Sarcopenia, Hypertension, Nutritional Status, Elderly Population.

ABSTRAK

Sarkopenia dan hipertensi adalah dua kondisi kesehatan yang sering terjadi pada populasi lanjut usia. Sarkopenia ditandai dengan penurunan massa otot dan kekuatan secara bertahap, sedangkan hipertensi merupakan faktor risiko utama penyakit kardiovaskular. Kedua kondisi ini dipengaruhi oleh berbagai faktor, termasuk status gizi. Penelitian ini bertujuan untuk mengetahui hubungan antara status gizi dengan perkembangan sarkopenia dan hipertensi pada populasi lanjut usia. Metode penelitian ini menggunakan studi observasional analitik dengan pendekatan potong lintang yang dilakukan di pusat kesehatan Pegandan dan Bululor. Data dikumpulkan melalui pengukuran antropometri, status gizi, aktivitas fisik, tingkat stress dan tekanan darah. Analisis data dilakukan menggunakan perangkat lunak statistik untuk menghasilkan statistik deskriptif. Hasil penelitian menunjukkan adanya hubungan antara status gizi yang obesitas dengan peningkatan risiko sarkopenia dan hipertensi pada populasi lanjut usia. Kesimpulan dari penelitian ini menekankan pentingnya deteksi dini dan intervensi yang tepat dalam mengatasi sarkopenia dan hipertensi untuk meningkatkan kualitas hidup dan kesehatan secara keseluruhan pada populasi lanjut usia.

Kata kunci: Sarkopenia, Hipertensi, Status Gizi, Populasi Lanjut Usia.

INTRODUCTION

Sarcopenia, the progressive loss of muscle mass and strength, and hypertension, characterized by high blood pressure, are prevalent health concerns globally, significantly affecting individuals' well-being. According to recent research, sarcopenia predominantly affects the elderly population, while hypertension is a primary risk factor for cardiovascular diseases. Occurring sarcopenia and hypertension present complex challenges in healthcare management. Both conditions are influenced by various factors, including nutritional status. (Damluji et al., 2023; Johri et al., 2023). Sarcopenia, a multifactorial condition, involves a gradual decline in muscle mass, strength, and function, leading to decreased physical performance and an increased risk of falls (Liguori et al., 2018). Diagnosis typically involves measuring muscle mass, grip strength, and physical performance, with prevalence expected to rise alongside the aging population, emphasizing the necessity for early detection and intervention strategies (Murat et al., 2021). These findings underscore the critical need for integrated approaches to address both sarcopenia and hypertension to enhance overall health outcomes and quality of life.

Hypertension, a prevalent medical condition marked by consistently elevated blood pressure levels exceeding the norm, poses grave health risks if left unchecked. According to the American Heart

Association (AHA), uncontrolled hypertension significantly heightens the likelihood of severe health complications, such as cardiovascular diseases (CVDs), stroke, and renal dysfunction (Hall et al., 2021). Diagnosis typically involves multiple blood pressure readings taken on separate occasions to accurately assess the condition's presence and severity. It's imperative to recognize that effective management of hypertension necessitates a complex approach encompassing lifestyle modifications, pharmacological interventions, and regular monitoring to mitigate the potential for adverse health outcomes and enhance overall well-being (Elendu et al., 2024).

Sarcopenia, characterized by age-related decline in muscle mass and function, shares a complex interplay of causative factors with hypertension. As outlined by the Asian Working Group on Sarcopenia, factors such as sedentary behavior, inadequate dietary protein intake, and comorbid chronic illnesses contribute significantly to its development and progression (Supriya et al., 2021). Likewise, the pathogenesis of hypertension is multifactorial, involving a combination of genetic predisposition and modifiable lifestyle factors such as poor dietary habits, physical inactivity, obesity, and psychological stress (Mansoor et al., 2022). A thorough understanding of the relationship between these factors is essential for formulating effective preventive and therapeutic measures, with the aim of reducing the impact of sarcopenia and hypertension on global health systems and improving patient outcomes.

Previous research has accurately investigated the intricate interplay between nutritional status and the propensity for sarcopenia and hypertension. These studies have elucidated the profound influence of dietary patterns, nutrient intake, and body composition on the pathogenesis of these multifactorial conditions (He et al., 2021; Srivastav et al., 2021; Terbah et al., 2023). Furthermore, comprehensive examinations into lifestyle determinants, including levels of physical activity and stress management strategies, have provided pivotal insights into both the mitigation and amelioration of sarcopenia and hypertension (Jurdana & Žiberna, 2023). Despite these advancements, there exists an imperative for continued research endeavors aimed at unraveling the nuanced mechanisms underpinning these associations and delineating targeted interventions for effective prevention and management.

Despite the existing body of research on sarcopenia and hypertension, there is a notable gap in understanding the comprehensive role of nutritional status in the development and progression of these conditions. Given the increasing prevalence of sarcopenia and hypertension globally, there is an urgent need to investigate the specific risk factors associated with nutritional status to inform preventive strategies and clinical interventions. Therefore, the primary objective of this study is to analyze the relationship between nutritional status and the risk of sarcopenia and hypertension, with a focus on identifying modifiable factors that can be targeted for effective management and prevention strategies.

This study is based on *research gaps* from previous studies. According to research by (Crovetto Mattassi et al., 2022) there is an association between nutritional status and sarcopenia based on BMI, and it was found that obese older adults have a higher risk of sarcopenia compared to those with normal nutritional status. Research by (Munyati Sulam, 2020) showed that nutritional status was significantly associated with the incidence of hypertension in the elderly, and this was supported by (Purba, T. H et al., 2023). However, there is no research that links nutritional status variables with sarcopenia and hypertension simultaneously.

METHOD

1. Participant characteristics and research design

The study is an observational analytic study with a cross-sectional approach. This design involves simultaneous observation of both independent and dependent variables at a specific point in time or over a short period. Each study subject is observed only once throughout the research duration. The study was conducted at health centers (Puskesmas) with the highest prevalence of obesity in Semarang City, specifically at Pegandan and Bululor health centers. This research was conducted during February 2024.

1. Sampling procedures

The population studied in this study were individuals who participated in health center activities, such as routine check-ups at integrated development posts (posbindu). Prosedure sampling employing a purposive sampling technique, subjects are chosen based on the assumption of population homogeneity regarding a specific characteristic, facilitating random selection. Each potential participant stands an equal chance of inclusion provided they meet the specified criteria. Inclusion criteria necessitate subjects to be adults aged 40 years or older, capable of active communication, and able to ambulate independently both indoors and outdoors. Conversely, exclusion criteria encompass the presence of autoimmune heart disorders and diabetes mellitus, occurrence of medical disturbances during measurement, Alzheimer's disease, utilization of implants that may affect measurement accuracy, as well as undergoing inpatient therapy or consumption of vitamin D supplements and medications influencing vitamin D levels within the preceding two weeks.

2. Sample size, power, and precision

The sample size was determined using the Lemeshow formula, as the population size was unknown. The calculation is as follows:

$$n = \frac{Z^2 \times p \times (1-p) \times N}{d^2 \times (N-1) + Z^2 \times p \times (1-p)}$$

Where:

n = minimum sample size

N = total population (300 people in the health centers)

$Z_{1-\alpha/2}$ = confidence level (95% = 1.96)

p = proportion of obesity cases (0.3461)

d = precision level/deviation (5%)

Based on these parameters, the sample size was calculated to be 150 respondents.

3. Measures and covariates

The primary independent variable is dietary acid load, and the dependent variables are sarcopenia and hypertension among obese individuals. Data collection involves:

- a. Demographic and health data collected through interviews and medical records.
- b. Measurements of height, weight, and BMI to assess obesity status.
- c. Evaluation of sarcopenia using muscle mass and function tests.
- d. Blood pressure measurements to assess hypertension.

4. Data analysis

The forthcoming analysis will utilize statistical software to execute both descriptive and inferential statistics. Descriptive statistics aim to succinctly encapsulate the demographic and health profiles of the participants. Meanwhile, the inferential statistics will involve several methods. Firstly, regression analysis will be employed to discern the potential correlation between nutritional status

and the incidence of sarcopenia and hypertension. Secondly, chi-square tests will be utilized to evaluate associations among categorical variables. Finally, analysis of variance (logistic regression) will be applied to compare means across various groups. Throughout these analyses, a significance level of $p < 0.05$ will be maintained, with confidence intervals computed at 95%.

RESULTS AND DISCUSSION

The study involved 152 subjects aged 40-84 years, predominantly female (123 women and 29 men). The mean waist circumference was 88.41 cm, indicating a high prevalence of obesity. Data collected included anthropometric measurements, nutritional status, energy intake, stress levels, physical activity, and waist circumference.

Table 1
Characteristics of Research Subjects

Variables	n	%
Blood pressure category		
Hypertension	86.0	56.6
No Hypertension	66.0	43.4
Sarcopenia Category		
Sarcopenia	74.0	48.7
No Sarcopenia	78.0	51.3
Physical Activity Category		
Normal	1.0	7.0
Lightweight	145.0	95.4
Medium	6.0	3.9
Category Stress Level		
Low	43.0	28.3
Medium	94.0	61.8
High	15.0	9.9
Category Nutritional status		
Obesity	101.0	66.4
Not Obese	50.0	32.9
Category percent energy intake		
Less than required	3.0	2.0
Good	38.0	25.0
More than needed	111.0	73.0
Category Waist circumference		
Normal	32.0	21.1
At Risk	120.0	78.9

Table 1. Shows that the blood pressure of hypertensive subjects is more 56.6% than the non-hypertensive subjects 43.4%. Percentage of energy intake that affects the acid-base balance of the body. In this study the category of intake more than the need reached 73%. While the stress level in this study showed 61.8% of subjects fell into the category of moderate stress levels.

Table 2
Relationship between Nutritional Status and Sarcopenia

Relationship between Nutritional Status and Sarcopenia								
Nutritional status	Sarcopenia Category				Total		Value p	OR
	Sarcopenia		No sarcopenia					
	n	%	n	%	n	%		
Not obese	17	34	33	66	50	33,1	0.013	2.416
Obesity	56	55.4	45	44.6	101	66.9		
TOTAL	152							

*uji Chi Square

Statistical tests revealed that 55.4% of individuals with obese nutritional status had sarcopenia compared to 34% in non-obese individuals. The chi-square test confirmed that no expected values were below 5, yielding a chi-square value of 6.1 and a p-value of 0.013, indicating a significant association between obesity and sarcopenia. An odds ratio of 2.416 further supports that individuals with obesity have twice the risk of developing sarcopenia.

Table 3
Relationship between Nutritional Status and Hypertension

Relationship between Nutritional Status and Hypertension								
Nutritional status	Hypertension Category				Total		Value p	OR
	Hypertension		Not hypertensive					
	n	%	n	%	n	%		
Not obese	22	44	28	56	50	33.1		
Obesity	64	63.4	37	36.6	101	66.9	0.024	2.201
TOTAL	152							

*uji Chi Square

The statistical tests indicate that among those with obese nutritional status, 63.4% are hypertensive and 36.6% are not, whereas among non-obese individuals, 44% are hypertensive and 56% are not. The chi-square test, with a value of 5.1 and $p=0.024$, confirms that no expected cell value is less than 5. These results demonstrate a significant relationship between obesity and hypertension, supported by an odds ratio of 2.201, suggesting that individuals with obesity have more than twice the risk of developing hypertension compared to non-obese individuals.

Table 4
Logistic Regression Test Results of Nutritional Status on the Occurrence of Sarcopenia

Variables	Model 1 ^a			Model 2 ^b		
	OR	95%CI	p	OR	95%CI	p
Not obese	1			1		
obesity	2.416	1.194-4.887	0.014	7.255	1.124-6.271	0.001

^aunadjusted; ^bconfounding variables: Usia, Tingkat pendidikan, Aktivitas fisik, Kategori Persentase Asupan Energi, Kategori Tingkat Stress, Kategori Lingkar Pinggang.* logistic regression

Table 5
Logistic regression test results of nutritional status on hypertension

Variables	Model 1 ^a			Model 2 ^b		
	OR	95%CI	p	OR	95%CI	p
Not obese	1			1		
Obesity	2.201	1.105-4.388	0.02	2.818	1.344-5.910	0.006

^aunadjusted; ^bconfounding variables: Usia, Tingkat pendidikan, Aktivitas fisik, Kategori Persentase Asupan Energi, Kategori Tingkat Stress, Kategori Lingkar Pinggang.* logistic regression

Multivariate test results Table 4. and Table 5. This study showed that obese nutritional status had a significant association with sarcopenia and hypertension. For sarcopenia, the p value = 0.014 indicates statistical significance. The odds ratio values of 2.416 in model 1 and 7.255 in model 2 indicate that people with obese nutritional status are twice as likely to have sarcopenia. Nutritional status was also significantly associated with hypertension, with odds ratio values of 2.201 in model 1 and 2.818 in model 2, indicating that people with obese nutritional status have twice the risk of developing hypertension.

From these findings, it can be inferred that obese nutritional status serves as a potential risk factor for sarcopenia and hypertension. Consequently, there is a pressing need for heightened attention to obesity management in both prevention and management efforts concerning health conditions like sarcopenia and hypertension. Emphasizing nutritional interventions and adopting healthy lifestyle behaviors may prove effective strategies in reducing the prevalence and risk of these conditions

among populations with obese nutritional status. (Papadopoulou-Marketou et al., 2023; Prado et al., 2024) research on the relationship between obesity and its health complications, such as sarcopenia and hypertension, has underscored the necessity for broader, holistic interventions in obesity management. This includes approaches involving dietary modifications, increased physical activity, and weight management. These findings align with the increasingly recognized holistic prevention approach in public health.

However, it's crucial to acknowledge that the relationship between obese nutritional status, sarcopenia, and hypertension is complex and multi-determinant. Factors such as genetics, environment, and lifestyle also influence this relationship. Thus, (Jyotsna et al., 2023) states that an individualized approach in managing these health conditions is imperative to ensure the effectiveness of interventions and optimal management. Evaluating the relationship between obesity and its comorbidities requires consideration of other potential risk factors that may contribute, such as family history, levels of physical activity, and dietary intake. (Larrabee Sonderlund et al., 2022) studies that account for these factors can provide a more comprehensive understanding of the dynamics of the relationship between obesity and other health conditions. In the context of healthcare provision, these findings provide a basis for increased monitoring and intervention among individuals with obese nutritional status to mitigate the risk of sarcopenia, hypertension, and other health complications. Health education aimed at raising awareness about the importance of weight management and healthy lifestyles can also be an integral part of prevention strategies.

LIMITATION OF THE STUDY

One notable limitation of the study is the lack of consideration for potential confounding variables that could influence the observed associations between obese nutritional status, sarcopenia, and hypertension. While the study highlights a significant association between these variables, factors such as genetics, environmental influences, and lifestyle behaviors were not thoroughly examined. As emphasized by (Jyotsna et al., 2023), these factors play a crucial role in the development and progression of obesity-related health conditions. Therefore, the absence of comprehensive data on these confounders may limit the generalizability of the findings and the ability to establish causal relationships. Additionally, the reliance on cross-sectional data in this study prevents the determination of temporal relationships, inhibiting the ability to infer causality. Future research should aim to incorporate longitudinal designs and account for a broader range of potential confounders to provide a more nuanced understanding of the complex interplay between obese nutritional status, sarcopenia, hypertension, and other related health outcomes.

CONCLUSIONS AND SUGGESTIONS

In conclusion, the study conducted at Bulu Lor Health Center and Puskesmas Pegandan in Semarang City illuminates a significant association between obese nutritional status and the prevalence of sarcopenia and hypertension among individuals aged 40-84 years. The findings reveal that obese individuals are twice as likely to develop sarcopenia and have a doubled risk of hypertension compared to their non-obese counterparts. These results underscore the urgent need for comprehensive obesity management strategies encompassing dietary modifications, increased physical activity, and weight management interventions. However, it's imperative to acknowledge the multifaceted nature of the relationship between obese nutritional status, sarcopenia, and hypertension, influenced by genetic, environmental, and lifestyle factors.

Therefore, future research endeavors should adopt an individualized approach and consider additional risk factors such as family history and dietary intake to yield a more comprehensive understanding of these complex interactions. Ultimately, these findings call for intensified

monitoring and intervention efforts targeting individuals with obese nutritional status to mitigate the risk of sarcopenia, hypertension, and other related health complications. Moreover, health education initiatives focusing on promoting awareness about the significance of weight management and adopting healthy lifestyle practices should be integrated into prevention strategies to address the burgeoning burden of obesity-related health conditions effectively.

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