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THE ASSOCIATION BETWEEN OBESITY AND HYPERTENSION AMONG ELDERLY RESIDING IN A NURSING HOME: IS GENDER IMPORTANT?

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ABSTRACT

Introduction: Elderly exhibit an increased for health complications, including obesity and hypertension (HT).. Obesity has been demonstrated to increase the risk of HT and the mechanism is also often influenced by gender. **Aims:** The study aimed to analyze the association between obesity and hypertension among elderly in nursing home stratified by gender. **Methods:** A cross-sectional study was conducted on a sample of 54 elderly subjects in nursing home. A sphygmomanometer was used to assess blood pressure (BIA) and a Bioelectrical Impedance Analysis (BIA) to determine nutritional status includingbody mass index (BMI), body fat (BF), visceral fat (VF), and subcutaneous fat (SF). Analysis of data was performed using an independent t-test and Pearson correlation test. **Results:** Mean age of respondents was 71.28 ± 8.21, dominated by women (75.9%), and 27.8% had hypertension. Dietary intake indicate excess sodium intake, while potassium, calcium, magnesium, vitamin D, vegetables, and fruits intake remain low. All indicators of nutritional status assessment differ significantly by gender except BMI. However, the present study found that BMI is the only variable associated with systolic BP (p=0.023). Stratified by gender, it was found that BW, BMI, and VF in women were related to systolic BP (p=0.022; p=0.015; p=0.040; respectively), and no such relationship was observed in men. **Conclusion:** It is proven that obesity and hypertension were more prevalent among elderly women. It is imperative to check nutritional statusfor preventive action for other diseases, including hypertension.

Keywords: elderly, hypertension, nursing home, obesity

INTRODUCTION

Suboptimal nutritional status is a common occurrence among the elderly population. A study in 23 nursing homes in Flanders reported that 38.7% of the residents were at risk for malnutrition and 19.4% were malnourished (Verbrugghe et al., 2013). High figures also occur in India, which stated that out of 360 elderly people, 55% are at risk of malnutrition and an additional 15% have experienced of malnutrition (Agarwalla et al., 2015). A study among older adults residing in Indonesia revealed that 26.23 % and 23% of the elderly are under nutrition and overweight/ obesity, respectively (Farapti et al., 2023). The prevalence of overweight individual is often observed to be higher among women, and statistically indicated a positive correlation between overweight andelderly females (Boscatto et al., 2013). Research in the Lafeite Coutinho region, Brazil indicated a positive correlation between overweight and hypertension. However, the study also found a negative association between obesity and hypertension among elderly people aged ≥75 years and older who reside independently. (Fares et al., 2012).

Excess nutritional status can be influenced by various factors, including gender. It is established that a decline in estrogen levels in older women can lead to an increased prevalence of various diseases, although it does not necessarily decrease in men. Early detection of malnutrition is necessary for earlier interventions (Sargento et al., 2014). In the elderly with Alzheimer's disease, an

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unfavorable psycho-functional condition has been observed to be associated with obesity (Saragat et al., 2012). The existing body of literature consistently demonstrated a robust correlation between sedentary lifestyle and physical activity on one hand, and body adipose on the other (Gomez-Cabello et al., 2011). Elderly who are overweight and obese generally exhibit a higher body fat (BF) percentage in comparison to their counterparts with optimal nutritional status (Alam et al., 2011). A healthy diet can improve body weight (BW) and also reduce the concentration of inflammatory markers (Calder et al., 2011). It has been demonstrated that this intervention is capable of reducing the risk of cardiovascular disease (CVD) in the elderly individual (Bulló et al., 2011).

The risk of CVD increases with age and hypertension (HT) is a cardiovascular disorder that requires attention from the elderly because HT is the strongest risk factor for almost all CVD (Bulló et al., 2011; Kjeldsen, 2018). The prevalence of HT in the elderly population across various regions worldwide is often classified as high (Gao et al., 2013; Ghaffari et al., 2016; Mendes et al., 2013). In Indonesia, he prevalence of heart failure (HF) among the elderly is high in both community and institutional settings, as well as in urban and rural areas (Astutik et al., 2021; Farapti et al., 2023). Obesity (OB) has been identified as a contributing factor to HT in the elderly. However, association between obesity and HT varies according to gender and age, leading to the classification of obesity-induced hypertension (Kotsis et al., 2015). A multitude of Population studies have demonstrated that being overweight is the largest contribution to hypertension (Astutik et al., 2021; Farapti et al., 2023). Moreover, dietary habit and lifestyle choice have been demonstrated to exert a considerable influence on the development of HT. This influence has been observed to manifest through various factors, including but not limited to: excessive body mass, a lack of, physical activity, inadequate intake of calcium and magnesium, low potassium intake, and also excessive intake of sodium (Farapti et al., 2017; Geleijnse et al., 2004).

Nursing home is a social institution that house elderly individuals, both female and male. Furthermore, the elderly in nursing home generally have low socioeconomic and poor health status (Farapti et al., 2023). Elderly dementia in nursing homes who experience hypertension have been observed to demonstrate diminished cognitive function (Wysocki et al., 2012). The prevalence of malnutrition in the elderly also increases with age (Serrano-Urrea and Garcia-Meseguer, 2013). In light of the preceding explanations, the researcher sought to examine the association between nutritional status and blood pressure (BP) in the elderly individuals residing in nursing home, and identify potential risk factors that may contribute to both conditions.

METHODS

This present study employed an analytic study design, adopting a cross-sectional approach. It was conducted from September to November 2021 in a nursing home, namely UPTD Griya Wreda in Surabaya. The study population comprised 54 elderly individuals. The inclusion criteria for the elderly include a minimum age of 60 years, adequate communication and memory skills, good health when data is collected, and willingness to participate in research. Elderly who had impaired liver, kidney function, and nerve function disorders related to grasping ability were excluded from the study. The respondents were selected through the implementation of a purposive sampling technique and the study included 54 elderly individuals.

The data of characteristic respondents including age, gender, and history of disease were obtained from the

UPTD Griya Wreda. This approach was taken to ensure the validity of the data and to minimize bias due to decreased physiological recall abilities of the elderly. Given that the residents of the nursing home were served the same daily menu from the food services, estimates of their nutritional intake could be calculated by evaluating the nutritional value of the food presented. Consequently, the dietary intake data presented was not directly based on each subject's intake. The measurement of blood pressure (BP) was performed by using an Omron sphygmomanometer with classification of normotension (systolic BP <130 and/or diastolic BP <85 mm Hg), pre hypertension (systolic BP 130–139 mm Hg and/or diastolic BP 85–89 mm Hg), and hypertension (systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg). The measurement of blood pressure was conducted twice and an average of each systolic and diastolic measurement subsequently calculated. Elderly subjects were requested to take a seat and relaxed prior to undergoing the blood pressure measurement. Nutritional status measurement (body mass index, body fat, visceral fat, subcutaneous fat) was performed with Bioelectrical Impedance Analysis (BIA) Omron HBF 375. The analysis of the data was conducted using an independent t-test and Pearson correlation test in Software Statistical Product and Service Solution (SPSS) 21.0 version with CI 95%. The research ethics review was formally endorsed by the Health Research Ethics Committee of the Faculty of Dentistry, Universitas Airlangga on July 7, 2021, bearing the following certification number: 357/HRECC.FODM/VII/2021.

RESULTS

A total of 54 older people residing in nursing home were selected as respondents. The average length of stay for these individuals was approximately 23.09 ± 16.76 months. The distribution of characteristics and hypertension status of respondents are summarized in Table 1. Most of the respondents were women (75.9%) and had a history of hypertension (37%) and uric acid (33.3%). The average systolic and diastolic blood pressures of the participants were found to be within the normal range. According to the patient histories and antihypertensive medications documented, 37% of the respondents were classified as subjects with hypertension status. However, at the time of the study, the distribution of patients based on blood pressure measurement was as follow: patients with HT were 27.8%, patient with pre-HT was 11.1%, and the remaining had normal blood pressure.

Table 2 shows the distribution of nutritional status characteristics among the elderly, with both overall and gender-based analysis conducted. A range of factors, including body weight (BW), body mass index (BMI), body fat (BF), visceral fat (VF), and subcutaneous fat (SF), were identified as contributors to the observed variations in the prevalence of these conditions among male and female subjects. The majority of the elderly have a normal BMI; however, based on BF, a prevalence of excess conditions is observed. A substantial disparity based on sex was observed in all indicators of nutritional status with the exception of BMI ($p > 0.05$). Men had a higher BW ($p = 0.047$), as did VF ($p = 0.043$). On the other hand, the BF of elderly women was above that of men ($p = 0.03$). From SF perspective, the prevalence is observed to be higher in women than in men in all of anatomical parts, including whole, arms, legs, trunk. However, it can be identified that in both men and women, the percentage of subcutaneous fat is predominantly located in the legs (men 23.13 ± 5.55; women 42.96 ± 7.04).

Table 1. Characteristics and Hypertension Status of Subjects

Variable	n	%	Mean ± SD

Variable	n	%	Mean ± SD
Age (Mean ± SD)			71.28 ± 8.21
55-64 y/o	10	18.5	
65-74 y/o	23	42.6	
≥75 y/o	21	38.9	
Gender			
Men	13	24.1	
Women	41	75.9	
History of Disease			
Diabetes Mellitus	8	14.8	
Uric Acid	21	38.9	
Hypercholesterolemia	17	31.5	
Hypertension	20	37.0	
Blood Pressure (mmHg)			
Systolic BP			127.03 ± 17.96
Diastolic BP			73.03 ± 9.06
Hypertension status based on measurement			
Normotension	33	61.1	
Prehypertension	6	11.1	
Hypertension	15	27.8	
Hypertension status based on HT history or consume antihypertension drug			
Normotension	34	63.0	
Hypertension	20	37.0	

Table 2. Characteristics of Nutritional Status Based on Gender

Characteristic	Total (n=54)	Women (n=41)	Men (n=13)	p-value
	Mean ± SD or n (%)	Mean ± SD or n (%)	Mean ± SD or n (%)	
Body Weight (kg)	51.13 ± 1.22	49.27 ± 12.48	56.98 ± 10.05	0.047β
Body Mass Index (kg/m^2)	21.60 ± 4.57	21.54 ± 4.88	21.78 ± 3.56	0.869
Obesity	9 (16.7)	8 (19.5)	1 (7.7)	
Normal	33 (61.1)	23 (56.1)	10 (76.9)	
Underweight	12 (22.2)	10 (24.4)	2 (15.4)	
Body Fat (%)	30.58 ± 7.26	32.21 ± 6.60	25.45 ± 7.08	0.003β
Fat	29 (53.7)	21 (51.2)	8 (61.5)	
Average	7 (13.0)	6 (14.6)	1 (7.7)	
Lean	18 (33.3)	14 (34.1)	4 (30.8)	
Visceral Fat Index	6.60 ± 5.11	5.81 ± 4.84	9.08 ± 5.33	0.043β
High	11 (20.4)	5 (12.2)	6 (46.2)	
Normal	43 (79.6)	36 (87.8)	7 (53.8)	
Subcutaneous Fat (%)				
Whole	25.25 ± 6.74	27.23 ± 6.09	18.32 ± 4.23	0.000β
Arms	20.48 ± 10.08	26.03 ± 8.68	17.67 ± 4.88	0.002β
Legs	34.62 ± 15.78	42.96 ± 7.04	23.13 ± 5.55	<0.001β
Trunk	32.26 ± 8.45	34.32 ± 7.75	21.92 ± 6.88	<0.001β

[β]significance <0.05 (independent t-test CI 95%)

As demonstrated in Table 3, overall, only BMI was related to BP in the elderly, and even then, only to systolic BP. When the data is stratified by gender, significant relationships are only appeared in women and not among men. Specifically, the nutritional status based on BW ($p = 0.022$; $r = 0.356$), BMI ($p = 0.015$; $r = 0.376$), and VF ($p = 0.040$; $r = 0.322$). The findings suggest a correlation between the rise in BW, BMI, and VF among elderly women residing in nursing homes and the escalation in systolic BP. The calculation of the correlation coefficient between the three variables indicates that the strength of the correlation between each variable tends to be similar. Therefore, is the correlation classified as weak.

Based on daily menus in nutrition services, the estimated intake respondent in nursing home can be seen in table 2. The intake data presented in this study is an average estimate of elderly intake in 1 cycle (14 days) of nutrition services, as a more in-depth review more of food waste was not a component of this study. It was found that respondents who consumed all portions served met the recommendations for adequate macro nutrient intake according to their age, with the exception of energy, protein, and fiber intake. Micro nutrient intake estimate data shows sodium intake exceeds the recommended level, while potassium, calcium, magnesium, and vitamin D remain significantly below the recommended adequacy figures. The consumption of vegetables and fruit was identified as low intake.

DISCUSSION

Majority of the respondents are women and the proportion of women in nursing home is notably higher, accounting for more than half of the total number of respondents. This finding is consistent with the findings of several studies in Indonesia (Farapti et al., 2023; Pramesona and Taneepanichskul, 2018). A review of the medical records revealed that a number of subjects had been diagnosed with various chronic diseases, including hypertension, high uric acid, hypercholesterolemia, and diabetes mellitus. The aging of the population has increased the prevalence of chronic diseases, with elderly people often affected by multiple chronic diseases, more frequently cardiovascular diseases, chronic respiratory diseases, metabolic syndrome and cancer (Fabbri and Ferrari, 2006; Hung et al., 2011). Hypertension has been identified as the most significant risk factors for CVD, particularly among the elderly population. it is estimated that over 68% of the population is hypertensive (Sierra, 2017). This present study revealed minimal variance in the prevalence of hypertensive status, based on measurement history, or antihypertensive drugs utilization. Nevertheless, the prevalence of HT in this study is sufficiently high. According to data from Indonesian National Health Survey of 2018, the prevalence of HT based on the consumption of AH drugs among individuals aged 55 years and over was 19.3%- 25.26% (Félix-Redondo et al., 2013; Ministry of Health of Indonesia I, 2018; Qin et al., 2014; Sierra, 2017).

Table 3. Relationship Between Nutritional Status with Blood Pressure in Elderly

Variable of Nutritional Status	Blood Pressure (mmHg)			
	Systolic		Diastolic	
	p-value	r	p-value	r
Total subjects (n=54)				
Body Weight	0.095	0.23	0.675	0.058
Body Mass Index	0.023[β]	0.310	0.635	0.066

Variable of Nutritional Status	Blood Pressure (mmHg)			
	Systolic		Diastolic	
	p-value	r	p-value	r
Body Fat	0.067	0.252	0.898	0.018
Visceral Fat Index	0.144	0.201	0.786	0.038
Subcutaneous Fat				
Whole	0.145	0.201	0.957	0.007
Arms	0.177	0.186	0.808	0.034
Legs	0.178	0.186	0.865	0.024
Trunk.	0.106	0.222	0.998	0.000
Women subjects (n=41)				
Body Weight	0.022$^{\beta}$	0.356	0.900	0.020
Body Mass Index	0.015$^{\beta}$	0.376	0.915	0.017
Body Fat	0.189	0.209	0.767	-0.048
Visceral Fat Index	0.040$^{\beta}$	0.322	0.970	0.006
Subcutaneous fat				
Whole	0.415	0.131	0.802	-0.040
Arms	0.340	0.153	0.893	0.022
Legs	0.576	0.090	0.699	-0.062
Trunk	0.324	0.158	0.698	-0.063
Men subjects (n=13)				
Body Weight	0.998	0.001	0.301	0.311
Body Mass Index	0.912	0.034	0.357	0.278
Body Fat	0.553	0.182	0.800	0.078
Visceral Fat Index	0.827	0.067	0.492	0.209
Subcutaneous fat				
Whole	0.699	0.119	0.850	-0.058
Arms	0.954	-0.018	0.748	-0.099
Legs	0.852	0.058	0.859	-0.055
Trunk.	0.663	0.134	0.914	-0.033

$^{\beta}$significance <0.05 (Pearson correlation CI 95%)

Hypertension is a comorbidity that most frequently manifests in the elderly individuals residing in nursing homes and the pattern is associated with age based on different identified sex (Moore et al., 2012). Nursing homes are places where elderly individuals receive care and attention to their physical health, nutrition intake, activity levels, as well as appropriate medication therapy. According to Lochner *et al.* (2011), the elderly in nursing home have BP that is more is more closely monitored and managed compared to their community-dwelling counterparts (Lochner et al., 2012). In Korea, the presence of a nurse-led home visitation program has been demonstrated to enhance elderly self-management in controlling high BP (Park and Kim, 2016). Moreover, it is imperative to acknowledge the significance of dietary intake in the control of hypertension (Farapti et al., 2020). In addition, research conducted in French and Italian nursing home has revealed an absence of a correlation between BP and morbidity or mortality among the elderly in the community. This observation is attributed to the presence of distinct hemodynamic characteristics among this demographic (Benetos et al., 2012). This is what probably causes the elderly in nursing home to homes exhibit lower BP levels, attributable to the consistent and directed HT management implemented by the institution. However, other factors have been identified as potential contributors to

this phenomenon, including psychosocial stress. As posited by Liu *et al*. (2017), the elderly individuals encountering psychosocial stress have a 2.4 times risk of HT (Liu et al., 2017). The social isolation frequently encountered among the elderly population has been demonstrated to elevate the probability of developing heart failure (HT) incidence up to 1.3 times (Momtaz et al., 2012). Nevertheless, the intake and physical activity of the elderly individuals who have been provided remains the responsibility of each individual in their daily lives. These factors affect the nutritional status of said individuals, which is one of the intermediaries for HT.

Table 4. Dietary Intake of Subjects Based on Daily Menus in Nutrition Services

Components	Mean dietary intake ± SD	Recommendation[δ]
Macro nutrient		
Energy (Cal)	1723.33 ± 198.66	1600-2150
Carbohydrate (g)	229.64 ± 45.29 (59.8%)	200-340
Fibers (g)	10.86 ± 3.21	20-30
Protein (g)	57.43 ± 9.35 (15.14%)	58-65
Fat (g)	44.58 ± 16.01 (25.07%)	40-60
Cholesterol (mg)	220.09 ± 115.03	180-325[β]
Micronutrient		
Sodium (mg)	2361.49 ± 598.72	1000-1400
Potassium (mg)	1725.76 ± 540.74	±4700
Magnesium (mg)	257.28 ± 69.11	320-360
Calcium (mg)	341.16 ± 225.34	±1200
Vitamin D (µg)	3.01 ± 3.55	15-20
Fruits (g)	80.36	200-250[γ]
Vegetables (g)	125.98	±400[γ]

[δ]Recommendation for age >50 years old for both male and female (Ministry of Health of Indonesia, 2019); [γ]Recommendation for age >50 years old for both male and female (Ministry of Health of Indonesia, 2014); [β]Institute of Medicine, 2005

Hypertension is frequently accompanied by nutritional deficiencies, which are prevalent among the elderly population. Even in Flanders, more than 50% of the elderly at nursing home are at risk or have experienced malnutrition (Verbrugghe et al., 2013). The majority of the elderly have high BF and normal BMI. According to Fukuoka et al. (2019), high BF and low BMI in one individual are at risk for sarcopenia in the elderly (Fukuoka et al., 2019). Fat greatly affects the body's metabolism including BP (Koster et al., 2010). However, when compared to high BF (53.7%), high VF was only experienced by one-fifth of respondents (20.4%). Even so, Kang *et al*. (2011) explained that android fat in the elderly is more at risk of metabolic syndrome than abdominal VF (Kang et al., 2011). Subcutaneous fat (SF) in the elderly is predominantly located in the legs and trunk. A cross-sectional study of elderly people in Jakarta has indicated a correlation between BF and truncal SF with insulin resistance (Dwimartutie et al., 2010). The most common nutritional status was identified by measuring BMI. However, this study revealed that there was no difference in BMI between male and female elderly. This finding aligns with the findings of a cross-sectional gender study, which reported that BMI is comparable across gender lines among the elderly population. The study further asserts that the measurement of fat mass and fat free mass provides a more accurate representation representative of the real condition in the elderly (Kirchengast, 2010). The assessment of obesity in the

elderly population should not only be through anthropometric indicators of BMI, but also BF as a risk factor associated with metabolic disorders (Batsis and Zagaria, 2018). According to the extant research, the us utilization of BMI cut off points established by the WHO is not appropriate to the elderly population due to their low sensitivity (de Vasconcelos et al., 2010). The physiological conditions of the elderly who experience a decrease in bone anatomy and physiology can result in a decrease in height, thereby increasing BMI in a state of constant BW (Cetin and Nasr, 2014).

According to BF, there are differences between male and female elderly individuals residing in nursing home. The mean BF in women was higher than that of men (32.21 ± 6.60 vs 25.45 ± 7.08). This assertion is further substantiated by a similar study employing a cohort design in California (Maskarinec et al., 2020). Menopausal elderly have decreased levels of estrogen which lead to increased aldehyde dehydrogenase-1 and adipogenesis regulation (Petrosino et al., 2014). This phenomenon leads to a prevalence of higher BF in elderly women compared to men because naturally they are not much dependent on estrogen. In contrast to BF, VF manifests at a higher rate in elderly men than in women. Research conducted in Korea also obtained similar results although with different units (Kim et al., 2011). The higher visceral fat in men (vs. women) is because in women there is a more active signaling activity of estradiol-ERα, which reduces autophagy and adipogenesis (Tao et al., 2018). It is important to note that these activities will decrease with age. According to Kim *et al.* (2011), VF can predict metabolic syndrome in elderly men and post-menopausal women, but research on pre-menopausal is still needed (Kim et al., 2011). In line with BF, SF was also higher in women. A study reported that SF in the elderly was higher than in younger people. Furthermore, within the elderly group, the proportion of females exhibiting SF was notably higher compared to their male counterparts.

Nutritional status has been demonstrated to exert an influence on the augmentation of BP. Among respondents, it is proven that only BMI is related unidirectional to BP, even then only systolic BP. Kaur *et al.* (2013) also found that BMI has a high significant correlation with systolic BP, while diastolic BP is related to the waist-hip ratio (Kaur et al., 2013). In contrast to the findings of a community-based study conducted on an elderly cohort, an increase in BMI is associated with impaired left ventricle diastolic function (Russo et al., 2011). Studies that have nearly equal male and female respondents report that BMI is related to both systolic and diastolic BP (Oladoyinbo et al., 2015). Hypertension that is induced by weight gain, particularly adipose tissue gain, is often referred to as obesity-induced HT (Hall et al., 2015). The increase in adipose leads to increased stiffness of the ventricular arteries, which places individuals at risk for the development of CVD (Fernandes-Silva et al., 2018). Overweight and obesity have been demonstrated to exert a crucial influence on microvascular dysfunction (Karaca et al., 2014). As Stępień *et al.* (2012) explained, the concentration of the hormone insulin, adiponectin, and leptin is also associated with obesity according to BMI in people with HT. However, it is preferable to use abdominal obesity (Stępień et al., 2012). It is necessary to acknowledge that the characteristics of a bad lifestyle is widely recognized as a significant catalyst for obesity-induced HT (Leggio et al., 2017).

When the data were stratified by gender, it was found that the variables BW, BMI, and VF in women were correlated (nearly as strong) with systolic BP. However, this phenomenon is not observed in elderly men The present study is consistent with other research that has demonstrated a comparable correlation

between obesity (based on BMI, waist circumference, waist to height ratio, waist to hip ratio) and HT only occurs in women (Chen et al., 2014). The inactivity of women is often compared to that of men, causing an increase in BW and BP (Doumas et al., 2013). This phenomenon attributable to the occurrence of hormonal imbalances, a common occurrence in menopausal women. The provision of proven hormone therapy that can suppress the progress of increasing BW and CVD as soon as women enter menopause (Rosano et al., 2007). The prevalence of elevated fat levels in women of all ages has been observed to be higher than men, a phenomenon that has been associated with an increased risk of developing obesity-induced hypertension. The underlying mechanisms include higher leptin levels, leptin receptor (ObR) expression, and aldosterone levels in women compared to men that trigger hypertension through increased sympathetic nerve activity and sodium retention. Leptin and aldosterone increase with the increase in BMI and adipose in women (Faulkner and Belin de Chantemèle, 2018). Adipose tissue has been demonstrated to be a rich source of cytokines , which can stimulate an increase the rate of inflammation and vascular dysfunction (Taylor and Sullivan, 2016). In obese individuals (based on BMI), it is known that an increase in VF has a 2.61 times risk of experiencing metabolic syndrome only in elderly women (Koster et al., 2010). Visceral fat in obese individuals has a more important role in increasing BP than peripheral fat (Kotchen, 2010). Upon entering the menopause period, most of the women experiencing a change in fat position, initially gynoid obesity tended to become android obesity (Rosano et al., 2007). Indeed, android fat is more at prone to metabolic syndrome when only compared to VF (Karastergiou et al., 2012). Therefore, a study explains that the term metabolic obesity , which refers to fat accumulation in both lean and obese individuals, represents a greater risk of CVD than the term obesity based solely on anthropometric measurements (Beasley et al., 2009).

Hypertension and obesity are the most important risk factors contributing to the high morbidity and mortality rates associated with cardiovascular disease. It is noteworthy that the prevalence of these conditions often increases in advanced age. The present study has demonstrated a correlation between overall BMI and systolic BP. This finding aligns with the results of the PURE Malaysia cohort study that advanced age and overweight or obese were associated with an elevated risk of prehypertension and hypertension (Ismail et al. 2023). Furthermore, obesity has been identified as a contributing factor to multimorbidity among Malaysian older adults (Shariff Ghazali et al. 2021). Epidemiological studies demonstrated that dietary and lifestyle habits exert a considerable influence on CVD, particularly on hypertension and obesity (Furqonia et al., 2023; Geleijnse et al., 2004). The National Health and Morbidity survey 2018 among older adults in Malaysia demonstrated that being physically inactive was independently associated with self-reported modifiable CVD risk factors (Chan et al. 2021). In the elderly population, there is frequently an inadequacy of high-quality nutrients, while there is often an excess of nutrient that fall below recommended levels. Some nutrients identified as risk factors of HT and OB are the excess of energy, carbohydrate, fat, and salt intake (Furqonia et al., 2023; Pinto de Souza Fernandes et al., 2017). The findings of the present study indicated that the sodium salt intake was excessive, with levels almost twice as high as the recommended amount. The degree of knowledge and behavior regarding salt intake were found related to adherence to healthy dietary pattern (Iaccarino Idelson et al., 2020). a preceding investigation of older people indicated that a low daily salt intake was associated with awareness of the harmful effects of

excessive salt intake (Farapti et al., 2020) In contrast, the present study demonstrated that the consumption of fruits and vegetables, fiber, potassium, calcium, magnesium, vitamin D was categorized as inadequate or lower than recommended. As indicated by the findings of previous studies, an inadequate diet characterized by a deficiency in essential nutrients has been demonstrated to be associated with hypertension and obesity (Boeing et al., 2012; Chiavaroli et al., 2019; Geleijnse et al., 2004; Slavin and Lloyd, 2012). Interestingly, the present study's focus on elderly individuals residing in nursing homes reveals noteworthy distinctions in their characteristics when compared to the broader community. The subjects were provided with a daily intake, which was based on a menu arranged by the food service. They consumed the same foods and were not permitted to acquire foods external sources. Consequently, the nutrient intake was not a confounding variable in this study. However, the actual intakes of each subject were not measured, and thus, the intakes may have differed from subject to subject. Further studies are required to measure food waste for each subject and other supplementary food apart from nursing homes. This will allow for precise measurement of nutrient intake and analysis of the correlation between intake and conditions such as hypertension and obesity. Lastly, the stratification analysis may not provide enough pool sample of elderly men compared to women. The observed association between gender and the outcome variables may be attributed to the underrepresentation of male subjects in the study. However, the ratio of elderly women to men is comparable to those population.

CONCLUSIONS

The majority of residents in nursing homes are female and have a medical a history of hypertension (HT). The most prevalent nutritional issue among the elderly is excessive body fat. Among the various nutritional status assessments, BMI emerged as the sole factor demonstrating a positive correlation with systolic BP. Following the stratification of the data based on gender, it was determined that relationship between nutritional status and systolic BP was present exclusively among the female subjects. It is imperative to ascertain the nutritional intake by food service and the nutritional status of the elderly in nursing home at the earliest possible juncture. This knowledge facilitates the implementation of preventive measures against other diseases, particularly heart disease (HT). Therefore, it is imperative to concurrently assess metabolic health status and obesity when implementing risk management strategies for hypertension (HT).

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