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DIETARY PATTERNS, PHYSICAL ACTIVITY AND OBESITY STATUS ON BLOOD PRESSURE IN HYPERTENSIVE PATIENTS

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ABSTRAK : POLA MAKAN, AKTIVITAS FISIK DAN STATUS OBESITAS TERHADAP TEKANAN DARAH PADA PENDERITA HIPERTENSI

In Indonesia, the prevalence of hypertension has increased significantly, from 25.8% in 2013 to 30.8% in 2023. The proportion of controlled hypertension reached only 19.8% in the productive age group and 17.7% in the elderly. This large number of uncontrolled hypertension cases contributes significantly to the increased risk of cardiovascular disease. The objective of this study was to ascertain the correlation between consumption patterns, physical activity, and obesity status with blood pressure in hypertensive patients in the work area of the Kemirimuka Village Health Center, located in Depok City. This is a quantitative study using a cross-sectional design. The sampling method used was non-probability total sampling, with a sample size of 178 respondents who met the inclusion criteria. The data collected were analyzed univariate and bivariate using the Chi-Square statistical test. The results showed that most of the hypertensive patients, 66.3%, had uncontrolled blood pressure. Statistical test results showed a significant inverse relationship between age and blood pressure (p=0.002 and OR=0.356). In addition, there was a significant relationship between the frequency of junk food consumption and blood pressure (p= 0.017 and OR= 2.269). While the variables gender (p=1.000), frequency of coffee consumption (p=0.154), physical activity (p=0.583), BMI (p=0.594) and BF% (p=0.517) were not associated with blood pressure in hypertensive patients. In conclusion, the elderly group had a 2.81 times lower risk of uncontrolled blood pressure than the productive age group, and frequent consumption of junk food was associated with a 2.269 times increased risk of uncontrolled blood pressure. Education about hypertension, with an emphasis on weight management and healthy eating, should be provided to all age groups.

Keywords: Hypertension, Blood pressure, dietary patterns, physical activity, obesity

ABSTRACT

Di Indonesia prevalensi hipertensi meningkat signifikan, dari 25,8% di tahun 2013 meningkat menjadi 30,8% ditahun 2023. Proporsi hipertensi yang terkendali hanya mencapai 19,8% pada kelompok usia produktif dan 17,7% pada kelompok usia lanjut. Banyaknya jumlah kasus hipertensi yang tidak terkendali ini berkontribusi besar terhadap meningkatnya risiko penyakit kardiovaskular. Tujuan penelitian ini untuk mengetahui hubungan pola konsumsi, aktivitas fisik dan status obesitas dengan tekanan darah pada pasien hipertensi di wilalayah kerja Puskesmas Kelurahan Kemirimuka Kota Depok. Penelitian ini bersifat kuantitatif, dengan menggunakan desain cross-sectional. Metode pengambilan sampel yang digunakan adalah non-probability total sampling, dengan jumlah sampel sebanyak 178 responden yang memenuhi kriteria inklusi. Data yang terkumpul dianalisis secara univariat dan bivariat dengan menggunakan uji statistik Chi-square. Hasil penelitian menunjukkan bahwa sebagian besar pasien hipertensi 66,3% memiliki tekanan darah tidak terkendali. Hasil analisis menunjukkan hubungan terbalik yang signifikan antara usia dan tekanan darah (p=0.002 and OR=0.356). Selain itu, terdapat hubungan yang signifikan antara frekuensi konsumsi *junk food* dengan tekanan darah (p= 0.017 and OR= 2.269). Sedangkan variabel jenis kelamin (p=1,000), frekuensi konsumsi kopi (p=0,154), aktivitas fisik (p=0,583), indeks massa tubuh (IMT) (p=0,594) dan persen lemak tubuh (PLT) (p=0,517) tidak berhubungan dengan tekanan darah pada pasien hipertensi. Kesimpulannya, kelompok usia lanjut memiliki risiko 2,81 kali lebih rendah untuk memiliki tekanan darah yang tidak terkontrol dibandingkan kelompok usia produktif, dan seringnya konsumsi junk food ditemukan berhubungan dengan peningkatan risiko 2,269 kali lebih tinggi untuk memiliki tekanan darah yang tidak terkontrol. Edukasi tentang hipertensi, dengan penekanan pada manajemen berat badan dan pola makan sehat, harus diberikan kepada semua kelompok usia.

Kata Kunci: Hipertensi, Tekanan darah, pola makan, aktivitas fisik, obesitas

INTRODUCTION

Globally, the number of adults living with hypertension has increased significantly from 650 million in 1990 to 1.3 billion in 2019. Within the Southeast Asia region, the prevalence of hypertension has increased from 29% to 32%, encompassing countries such as India, Nepal, Indonesia, and Thailand (World Health Organization, 2023). Uncontrolled hypertension poses a substantial public health concern for hypertensive patients in both developed and developing countries, as it contributes to an elevated risk of cardiovascular disease, stroke, and premature mortality (Gebremichael et al., 2019; World Health Organization, 2023).

Hypertension constitutes a significant and growing public health concern in Indonesia. The prevalence of hypertension has exhibited a marked increase from one year to the next. According to the 2023 Indonesian Health Survey (SKI), the prevalence of hypertension in the population over 18 years of age was documented at 30.8%, with the proportion of controlled hypertension in the productive age group reaching only 19.8% and in the elderly age group, 17.7% of those diagnosed by a doctor (Health Development Policy Agency, 2023). This figure is notable when compared to the 2013 Indonesian Health Survey, which documented the prevalence of hypertension at 25.8% among the adult population (Health Research and Development Agency, 2013). In West Java Province, there was a reported increase from 29.4% in 2013 (Health Research and Development Agency, 2013) to 34.4% in 2023, placing it third among provinces with the highest prevalence of hypertension (Health Development Policy Agency, 2023). Specifically, in the city of Depok, hypertension is among the ten most prevalent diseases among outpatients in health centers and hospitals (RS) in 2023. At the Kemiri Muka Health Center, for instance, the number of individuals diagnosed with hypertension reached 8,878, of whom only 30.3% received the recommended treatment (Depok City Health Office, 2024).

Hypertension, if not adequately managed, can lead to adverse outcomes such as heart attacks, strokes, and chronic kidney disease (Meelab et al., 2019; Mills et al., 2020). In 2018, the financial burden of catastrophic disease services accounted for 22 percent of the total cost of the National Health Insurance (JKN) in Indonesia. Among the catastrophic diseases that incur the highest expenditures are cardiovascular disease, stroke, cancer, and kidney failure (Djamhari et al., 2020). Hypertension, in addition to its significant economic burden, leads to considerable expenditures due to its complications, both for patients and families, including the costs of care, treatment, rehabilitation, and loss of productivity (Feigin et al., 2023; Hird et al., 2019). Consequently, the prevention and control of hypertension have emerged as pressing concerns in the realm of public health and medical care. Hypertension is a disease caused by a combination of factors, including factors that cannot be changed, such as genetics, age, gender, and race. In addition, factors that can be changed include lifestyle factors such as diet, physical inactivity, obesity, stress, sleep duration, certain medications, smoking, and excessive alcohol consumption (Charchar et al., 2024). Evidence shows that lifestyle changes such as reducing salt, sodium, and fat intake, changing dietary habits to include more fruits and vegetables, not smoking, exercising regularly, maintaining a healthy body weight, and minimizing stressful conditions are effective in lowering blood pressure and preventing uncontrolled hypertension and its complications such as cardiovascular disease (Modey Amoah et al., 2020; Ojangba et al., 2023).

A study conducted on adults in the United States (US) found that 47% of total energy, 48% of saturated fat intake, 75% of sugar intake, and 46% of sodium intake consumed by the US public came from junk food (Dunford et al., 2022). In Indonesia, the proportion of individuals who consume sweet, salty, fatty foods and condiments ≥ 1 time per day is 33.7%, 30.4%, 37.4%, and 73.8% nationally. Conversely, the proportion who consume fruits and vegetables ≥ 5 servings per week is a mere 3.3% (Health Development Policy Agency, 2023). A study in Canada found a significant association between a preference for foods high in salt and fat and poor dietary quality (Carbonneau et al., 2021). Junk food is defined as unhealthy food, that is high in sugar, fat, and/or salt, yet low in nutrients (Maternal and Child Survival Program, 2019). Junk food is significantly associated with the risk of hypertension (Batubo et al., 2023; Y. Zhang et al., 2021). High consumption of junk food increases the likelihood of hypertension by 41% compared to those with low consumption (Batubo et al., 2023).

Another consumption pattern that affects hypertension is coffee consumption (Tat et al., 2023). Daily coffee consumption for two years significantly increased mean systolic blood pressure by 8.63 mmHg (Kujawska et al., 2021), and consumption >3 times per week was associated with a 4.5-fold increased likelihood of uncontrolled blood pressure in hypertensive patients (Solomon et al., 2023). In particular, the adverse effects of coffee involve the entire cardiovascular system and may lead to an

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excessive relative risk of new-onset hypertension and worsening blood pressure control (Borghi, 2022).

Physical activity has a major impact on blood pressure stability. Studies have shown that a lower prevalence of hypertension is associated with higher levels of physical activity (Ribeiro Junior & Fernandes, 2020; Rissardi et al., 2020). Physical activity reduces blood pressure by decreasing sympathetic nerve activity and widening the arterial lumen, thereby reducing peripheral vascular resistance. In addition, physical activity can reduce left ventricular mass index, which can lower blood pressure in people with hypertension (Shariful Islam et al., 2023).

A growing body of evidence supports the notion that obesity is a causal factor in the development of hypertension (Zaen et al., 2023). Obesity is most accurately defined as the abnormal or excessive accumulation of body fat to the point of compromising health (Shariq & Mckenzie, 2020). The most commonly used simple anthropometric indices to assess obesity status are body mass index (BMI) and body fat percentage (BF%) (Ge et al., 2021; Lee et al., 2022), and it has been widely reported that higher BF% and/or BMT often indicate higher risk levels of hypertension and cardiovascular disease (T. T. Nguyen et al., 2022; Lee et al., 2022). A hospital-based cross-sectional study demonstrated that a BMI of ≥25 kg/m² was a significant predictor of uncontrolled hypertension (Gebremichael et al., 2019). However, BMI is a measure that does not differentiate between lean muscle mass and fat mass. Furthermore, it does not indicate body fat distribution (Shariq & Mckenzie, 2020). Additionally, it does not account for age- and sex-related differences in body composition (Macek et al., 2020). A mounting body of evidence indicates that elevated BF% is significantly associated with cardiometabolic risk factors, even among individuals with a normal BMI (Park et al., 2019). Consequently, BF% has been proposed as an alternative adiposity measure to predict hypertension risk (R. Li et al., 2020; T. T. Nguyen et al., 2022). Numerous studies have demonstrated a significant positive correlation between BF% and the prevalence of hypertension (R. Li et al., 2020; Park et al., 2019; B. Zhang et al., 2021). These findings underscore the clinical utility of BMI and BF% as indicators of obesity status associated with hypertension.

As people age, they are increasingly susceptible to developing hypertension. According to the 2023 SKI, the prevalence of hypertension, as determined by measurement results, was 10.7% in the 18-24 age group, 27.2% in the 35-44 age group, and 64.0% in the 75+ age group (Health Development Policy Agency, 2023). This is in line with research conducted by Liew et al., who examined a multi-ethnic Asian population residing in Singapore. Their study demonstrated that older age (>50 years) consistently correlates with uncontrolled hypertension (Liew et al., 2019). Furthermore, the prevalence of hypertension is higher in males than in females and increases significantly with age (World Health Organization, 2023). Males aged <45 years and females aged >45 years have a higher risk of hypertension (Ojangba et al., 2023). In light of the aforementioned description, the objective of this study is to examine the impact of consumption patterns, physical activity, and obesity status on blood pressure in the hypertensive population. This investigation seeks to elucidate the underlying factors contributing to blood pressure control in hypertensive patients. As well as in reducing complications that can occur. This study is expected to provide more comprehensive insight to support hypertension management strategies through interventions based on modification of these risk factors.

RESEARCH METHODS

This research uses a quantitative approach with a cross-sectional methodology. It was conducted in the Kemiri Muka Urban Village Health Center from November to December 2023. The study was approved by the Research Ethics and Community Service Commission, Faculty of Public Health, University of Indonesia (Number: Ket-749/UN2.F10.D11/PPM.00.02/2023). The study population comprised individuals diagnosed with hypertension who received treatment and routine checkups every month and participated in the Prolanis and Posbindu programs within the Kemiri Muka Health Center in Depok City. The study employed a non-probability sampling technique, specifically a total sampling method, and the final sample size was 178 respondents. The study's inclusion criteria were hypertensive patients aged ≥ 18 years undergoing treatment or having routine blood pressure checks every month, who could communicate effectively and were willing to participate. Exclusion criteria included those who were ill, had memory problems, and were unable to stand upright.

In this study, the dependent variable is controlled and uncontrolled blood pressure by looking at the patient's blood pressure (<140/90 mmHg for respondents aged <60 years and <150/90 mmHg for those aged ≥60 years) (James et al., 2014). Blood pressure was measured twice using an

Omron-brand sphygmomanometer or tensiometer, and the average of the two recorded readings was used as the blood pressure outcome. The independent variables in this study were the characteristics of the respondents (age and gender), frequency of junk food and coffee consumption, physical activity, BMI and BF%.

Consumption pattern data consisting of the frequency of junk food and coffee consumption were obtained from the Semi-Quantitative Food Frequency Questionnaire (SFFQ) to determine the amount and type of junk food and coffee consumed by the residents of Depok City. The type of junk food includes four categories of food: Sweet (chocolate, cookies, cakes/sponge cakes, ice cream, donuts, waffles), Sweet beverages (sweetened condensed milk, soft drinks, sweet tea), Fast food (burgers, Kentucky chicken, French fries, pizza, nuggets, meatballs, sausages, chicken noodles, malang fritters, siomay, kebab), and Salty snacks (instant noodles, chips, canned food, fried food, corned beef, instant noodles) (Dunford et al., 2022; Mititelu et al., 2023). Respondents were asked to rate the frequency of consumption of each type of junk food and coffee using a predetermined food list. The collected data were then categorized based on statistical tests as the data were not normal. The categorization of the data was executed by the median value. The frequency of junk food consumption was designated as "often" if the total frequency exceeded the median value. The categorization of coffee consumption followed a similar methodology.

Physical activity assessment in this study used the International Physical Activity Questionnaire - Short Form (IPAQ-SF). The questionnaire contains questions about three types of specific activities from four domains, namely walking, moderate-intensity activity, and vigorous-intensity activity, which are expressed in MET (Metabolic Equivalent Task) units. MET for walking is set at a ratio of 3.3, moderate-intensity activity at a ratio of 4.0 and vigorous-intensity activity at a ratio of 8.0. Total physical activity is calculated using the formula (MET-minutes/week) = [walking (METs x minutes x days) + moderate-intensity activity (METs x minutes x days) + vigorous-intensity activity (METs x minutes x days)] (Dun et al., 2021). The calculation results are then categorized into light, moderate, and heavy physical activity (Benítez-Porres et al., 2013). A total value of <600 MET minutes/week is "light"; ≥600 - 3000 MET minutes/week is "moderate"; and ≥3000 MET minutes/week is "heavy."

Two methods were used to determine obesity status, namely obesity status determined by BMI and BF% measurements. To obtain data on obesity status based on BMI, anthropometric measurements of body weight (BW) were performed using a TANITA BC 541 digital scale in kilograms, and height (H) was measured using a microtoise with a height of 0.1 cm, then using the kg/m² equation, and obesity was defined as BMI ≥ 25 kg/m² according to the BMI guidelines of the Asia-Pacific criteria (Mulyasari et al., 2023). The measurement of obesity status based on BF% was assessed using Omron's Bioelectrical Impedance Analysis (BIA) analysis tool. BIA is a tool that achieves 83% and 90% accuracy, indicating the feasibility of the body composition index to predict hypertension with acceptable accuracy (Nematollahi et al., 2023). The BF% cutoff for obesity is ≥ 35% for women and ≥ 25% for men (Chen et al., 2021).

Univariate and bivariate analyses were used in this study. Univariate analysis describes the characteristics of the respondents. Bivariate analysis examines whether there is a relationship between age, gender, frequency of junk food consumption, frequency of coffee consumption, physical activity, BMI, and BF% with blood pressure in patients with hypertension using the chi-squared statistical test.

RESEARCH RESULTS

Univariate Analysis

Table 1 shows the distribution of respondents in this study. The percentage of respondents with uncontrolled blood pressure is higher at 66.3%, while the percentage of respondents with controlled blood pressure is 33.7%. In terms of age, elderly respondents (≥ 60 years) and productive age (< 60 years) were almost equal at 44.9% and 55.1%, respectively. Gender in this study was dominated by females with 87.6% and males with 12.4%. The frequency of junk food consumption was evenly distributed, with 50% of the respondents consuming junk food often and the other 50% consuming it rarely. A similar distribution was observed for coffee consumption, with 50% of the respondents consuming coffee often and the other 50% consuming it rarely. Regarding physical activity, 35.4% of respondents engage in light physical activity, 48% in moderate activity, and 16.3% in heavy activity. The majority of the respondents are obese, where the obese BMI is 65.2% compared to the normal BMI of 34.8%. Meanwhile, obese BF% was 65.7% and normal BF% was 34.3%.

Table 1

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Frequency Distribution of Characteristics

Characteristic	Frequency (n)	Presentation (%)
Blood Pressure		
Uncontrolled	118	66,3
Controlled	60	33,7
Age		
Elderly (≥ 60 years)	80	44,9
Productive Age (< 60 years)	98	55,1
Gender		
Male	22	12,4
Female	156	87,6
Frequency of Junk Food Consumption		
Often	89	50
Rarely	89	50
Frequency of Coffee Consumption		
Often	89	50
Rarely	89	50
Physical Activity		
Light	63	35,4
Moderate	86	48,3
Heavy	29	16,3
BMI		
Obesity	116	65,2
Normal	62	34,8
BF%		
Obesity	117	65,7
Normal	61	34,3

Bivariate Analysis

Table 2
Correlation between Individual Characteristics and Blood Pressure of Hypertensive Patients

Individual Characteristics	Blood Pressure				Total		OR (95%CL)	P-Value
	Uncontrolled		Controlled					
	n	%	n	%	n	%		
Age								
Elderly (≥ 60 years)	43	53,8	37	46,3	80	100	0,356 (0,188 – 0,677)	0,002
Productive Age (< 60 years)	75	76,5	23	23,5	98	100		
Gender								
Male	15	68,2	7	31,8	22	100	1,103 (0,424 – 2,869)	1,000
Female	103	66,0	53	34,0	156	100		

Table 2 shows that 75 respondents (76.5%) of productive age (<60 years) were identified as having uncontrolled blood pressure, compared to 43 respondents (53.8%) of elderly age (≥60 years). Statistical test results show that there is a significant inverse association between age and blood pressure in hypertensive patients (p-value 0.002 and OR: 0.356, 95% CI: 0.188-0.677), which means that the elderly group (≥60 years) is at risk. 2.81 times less likely to have uncontrolled blood pressure compared with the productive age group. (<60 years). The analysis also shows that there are gender differences, males have a higher prevalence of uncontrolled blood pressure with 15 respondents (68.2%) compared to females with 103 respondents (66%). Statistical test results show that there is no significant relationship between gender and blood pressure in hypertensive patients (p-value 1.000).

Table 3

Correlation between Consumption Patterns and Blood Pressure of Hypertensive Patients

Consumption Patterns	Blood Pressure				Total		OR (95%CL)	P-Value
	Uncontrolled		Controlled					
	n	%	n	%	n	%		
Frequency of Junk Food								
Often	67	75,3	22	24,7	89	100	2,269	0,017
Rarely	51	57,3	38	42,7	89	100	(1,198 – 4,299)	
Frequency of Coffee								
Often	64	71,9	25	28,1	89	100	1,659	0,154
Rarely	54	60,7	35	39,3	89	100	(0,885 – 3,110)	

Table 3 shows that among the respondents who often consume junk food, 67 respondents (75.3%) have uncontrolled blood pressure. In contrast, among those who rarely consume junk food, 51 respondents (57.3%) have the same problem. Statistical analysis reveals a significant relationship between the frequency of junk food consumption and blood pressure in hypertensive patients (p-value 0.017). The analysis also shows an odds ratio (OR) of 2.269 with a 95% confidence interval (CI) of 1.198 to 4.299. This suggests that patients who often consume junk food are 2.269 times more likely to have uncontrolled blood pressure than those who rarely consume it. Regarding coffee consumption, among respondents who often consume coffee, 64 respondents (71.9%) have uncontrolled blood pressure. Conversely, among those who rarely consume coffee, 54 respondents (60.7%) have uncontrolled blood pressure. Statistical test results show that there is no significant relationship between the frequency of coffee consumption and blood pressure in hypertensive patients (p-value 0.154).

Table 4
Correlation between Physical Activity and Blood Pressure of Hypertensive Patients

Physical Activity	Blood Pressure				Total		OR (95%CL)	P-Value
	Uncontrolled		Controlled					
	n	%	n	%	n	%		
Light	39	61,9	24	38,1	63	100	1,267 (0,500 – 3,215)	
Moderate	58	67,4	28	32,6	86	100	1,615 (0,618 – 4,219)	0,583
Heavy	21	72,4	8	27,6	29	100	1,000	

Table 4 shows that respondents with heavy physical activity had uncontrolled blood pressure as many as 21 respondents (72.4%), compared to respondents with moderate physical activity 58 respondents (67.4%) and light physical activity 39 respondents (61.9%). %). Statistical test results show no significant relationship between physical activity and blood pressure in hypertensive patients (p-value 0.583).

Table 5 shows that 79 respondents (68.1%) with obese BMI have uncontrolled blood pressure compared to 39 respondents (62.9%) with normal BMI. Statistical test results show no significant relationship between BMI and blood pressure in hypertensive patients (p-value 0.594). Other anthropometric findings, namely, BF%, show that 80 participants (68.4%) with obese BF% had uncontrolled blood pressure compared to 38 participants (62.3%) with normal BF%. Statistical test results show no significant relationship between BF% and blood pressure in hypertensive patients (p-value 0.517).

Table 5
Correlation between Obesity Status and Blood Pressure of Hypertensive Patients

Obesity Status	Blood Pressure	Total

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	Uncontrolled		Controlled				OR (95%CL)	P-Value
	n	%	n	%	n	%		
BMI								
Obesity	79	68,1	37	31,9	116	100	1,259 (0,660 – 2,404)	0,594
Normal	39	62,9	23	37,1	62	100		
BF%								
Obesity	80	68,4	37	31,6	117	100	1,309 (0,685 – 2,502)	0,517
Normal	38	62,3	23	37,7	61	100		

DISCUSSION

The results of the study showed a significant inverse association between age and blood pressure in hypertensive patients (p-value 0.002 and OR: 0.356, 95% CI: 0.188-0.677), which means that the elderly group (≥60 years) is at risk. 2.81 times less likely to have uncontrolled blood pressure compared with the productive age group. (<60 years). This is consistent with research by Nolde et al (2024), showing that the onset of the age-related increase in blood pressure begins at a relatively young age, possibly highlighting the important role of the middle-aged phase (around 30-60 years) in the development of blood pressure trends in the population. In line with this study, a study conducted in Jordan showed that patients aged ≥50 years had better blood pressure control compared to younger patients (<50 years) (Khader et al., 2019). A study in Mexico reported a shift in hypertension to younger ages over time (Castro-Porras et al., 2021). An inverted U-shaped trend of increasing blood pressure was observed, with a peak in men aged 40-59 years and high systolic blood pressure increased more rapidly in women aged 35-55 years (first phase) than later, aged 55-80 years (second phase) (Cheng et al., 2022).

In a US population study, young adults (18-39 years) who were aware of having hypertension were 5.7 times more likely than elderly groups to be untreated for hypertension, resulting in uncontrolled blood pressure (Sakhuja et al., 2021). Higher awareness and control of hypertension in elderly patients may be associated with frequent visits to health care facilities due to comorbidities, which increases the likelihood of being informed about their blood pressure and being prescribed medication to control hypertension (Khader et al., 2019). Productive-age patients choose not to initiate antihypertensive treatment due to a low perceived risk of cardiovascular disease (Sakhuja et al., 2021). A study in a Chinese general hospital confirms that hypertension is more common in middle-aged people (30-59 years) and highlights the need for special attention to blood pressure measurement and control in this group (Cheng et al., 2022). A cohort study reported that productive age (>60 years) is a critical period, as changes in blood pressure during productive age can have a significant impact on the lifetime risk of cardiovascular disease (B. Nguyen et al., 2019). Importantly, this period has also been shown to be important for health outcomes such as cognitive decline and dementia. Early and sustained intervention in hypertensive patients for age-related blood pressure control may be needed to counteract these adverse effects (Nolde et al., 2024).

Based on the results of our study, there was no significant relationship between gender and blood pressure in hypertensive patients (p-value 1.000). This finding is consistent with the results of a previous study conducted by Gebremichael et al (2019), which showed no relationship between gender and uncontrolled blood pressure in adult hypertensive patients at Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia, and the study by Here et al. (2022), which showed that gender was not associated with the incidence of hypertension, with males and females having relatively equal chances of experiencing hypertension. However, based on previous studies, there is an association between gender and blood pressure in hypertensive patients (Modey Amoah et al., 2020; Rachmawati et al., 2024). Population-based studies in Iranian adults showed that the prevalence of uncontrolled hypertension was higher in males than females. In addition, multiple regression analysis showed that the risk of uncontrolled hypertension was 1.2 times higher in males than in females (Farhadi et al., 2023).

Research in multiethnic Asian populations has shown that men are more likely than women to be untreated (Liew et al., 2019) and to have three or more unhealthy behaviors, such as low adherence to a healthy diet, being overweight, smoking, and drinking alcohol. This makes them 1.67 times more likely to have uncontrolled hypertension (Cherfan et al., 2020). Biological and hormonal differences also affect blood pressure regulation. At younger ages, women have significantly lower systolic blood pressure levels than men. Estrogen hormones in women have a protective effect by promoting vasodilation and lowering blood pressure, especially during reproductive age. Androgen hormones in men increase the activity of the renin-angiotensin system

(RAS), which causes vasoconstriction and sodium reabsorption in the kidneys. This increases blood pressure in men compared to women (Reckelhoff, 2023). However, with age, and especially after menopause, the difference between women and men decreases significantly, with similar blood pressure levels in women and men between the ages of 60 and 70 (Nolde et al., 2024).

In Indonesia, the tendency to eat out, including the consumption of fast food and street snacks, also known as junk food, has been on the rise, especially among the urban population. Busy lifestyles, especially among women entering the workforce, have limited time to cook at home. Junk food is the main choice because it is more affordable and easily accessible (Anyanwu et al., 2023). However, these foods contribute significantly to high intakes of sugar, salt, and fat, which have negative health effects (Andarwulan et al., 2021). Research shows that the Healthy Eating Index score of most people in Indonesia is below 51 out of 99%, reflecting the low quality of consumption patterns. This extraordinary dietary transition may have worsened health outcomes, particularly by increasing cardiovascular risk factors such as hypertension (Anyanwu et al., 2023).

The results of the present study showed a significant association between the frequency of junk food consumption and blood pressure in hypertensive patients (p-value 0.017). The analysis also shows an odds ratio (OR) of 2.269 with a 95% confidence interval (CI) of 1.198 to 4.299. This suggests that patients who often consume junk food are 2.269 times more likely to have uncontrolled blood pressure than those who rarely consume it. This finding is consistent with a study conducted in Southwest China, which showed a significant association between junk food consumption patterns and the risk of hypertension. Individuals in the low category of junk food consumption patterns had a 23% lower risk of hypertension (OR: 0.783, 95%CI: 0.682-0.899) compared with individuals in the moderate consumption category (Y. Zhang et al., 2021).

Studies in West Africa and Iran also reported that junk food consumption was associated with an increased risk of hypertension (Azemati et al., 2020; Batubo et al., 2023). Those with hypertension had a significant OR for high-fat foods (Thapsuwan et al., 2024). The results of the meta-analysis support biochemical evidence linking fast foods, which are often high in saturated and trans fats, sodium, and oxidation by-products, to increased blood pressure through several mechanisms (Batubo et al., 2023). The underlying mechanism for this association may be related to the high sugar, salt, and fat content of junk food, which may trigger sympathetic nervous system activity and sodium retention (Azemati et al., 2020). High fructose load increases renal salt reabsorption and also modulates the renin-angiotensin-aldosterone system, leading to increased blood pressure (Komnenov et al., 2019). In addition, high sodium intake causes water retention, increases systemic peripheral resistance, impairs endothelial function, alters the structure and function of large elastic arteries, and modifies sympathetic nervous system activity, which may contribute to the development of hypertensive disease (Grillo et al., 2019).

The results of the study showed no significant association between the frequency of coffee consumption and blood pressure in hypertensive patients (p-value 0.154). This finding is consistent with research by Miranda et al. (2021), which showed that there was no association between coffee consumption >3 cups/day and the risk of hypertension (OR 0.85, 95% CI: 0.70-1.04). Similarly, Ruben et al (2024) found no significant association between coffee consumption and the incidence of hypertension. On the other hand, according to research by Kujawska et al (2021), daily coffee drinking was associated with a significant increase in systolic blood pressure, with a mean of 8.63 mmHg after two years, compared with those who never or very rarely drank coffee. Research in Ethiopia showed that regular coffee consumption (≥ 3 times/week) was associated with a 4.5 times higher risk of uncontrolled blood pressure in hypertensive patients (Solomon et al., 2023). This is because the effect of caffeine in coffee is thought to increase blood pressure. This increase is due to an increase in systemic vascular resistance. In addition, caffeine can stimulate the adrenal glands to release adrenaline, which increases heart rate and causes vasoconstriction, leading to an abnormal increase in blood pressure (Islam et al., 2023).

Although some studies suggest adverse effects, a systematic review showed an inverse association between coffee consumption and the risk of hypertension (Haghighatdoost et al., 2023). This may be because, besides caffeine, coffee contains antihypertensive nutrients (vitamin E, niacin, potassium, and magnesium) and polyphenols, which also have vasodilator and antihypertensive properties (Borghi, 2022; Haghighatdoost et al., 2023). These factors may have contributed to the uncertainty in the relationship between coffee consumption and hypertension, and the results showed no significance.

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Based on the results of our study, it show that there is no significant relationship between physical activity and blood pressure in hypertensive patients (p-value 0.583). This finding is consistent with the study conducted by Istiana et al (2022), which revealed that there was no relationship between physical activity and the incidence of hypertension in the work area of the Ampenan Health Center, Mataram City, West Nusa Tenggara Province (NTB). In addition, the study by Ardiani et al (2023), found no correlation between the frequency of physical activity (walking, moderate, and heavy physical activity) and systolic blood pressure. Conversely, the study by Nguyen et al. (2019) demonstrated a significant relationship between low physical activity and the incidence of hypertension. A similar relationship was observed in the study by Rissardi et al (2020), which indicated a lower prevalence of hypertension among individuals engaging in higher levels of physical activity. The study by Ribeiro Junior & Fernandes (2020) further underscores this association, finding that individuals who engage in only one type of physical activity or are completely inactive have a 62% higher risk of developing high blood pressure compared to those who are more active.

A systematic review of 17 meta-analyses reported the combined effect of physical activity on reducing blood pressure by 5 mm Hg to 8 mm Hg in hypertensive patients and 2 mm Hg to 4 mm Hg in prehypertensive samples (Pescatello et al., 2019). The mechanism underlying this relationship may be related to sustained post-exercise vasodilation, which refers to increased blood flow to blood vessels after cessation of exercise. The underlying mechanism of vasodilation involves the release of nitric oxide (NO) by endothelial cells and the subsequent activation of the histamine pathway. NO exerts its effects by relaxing vascular smooth muscle and antagonizing sympathetic nerve constrictors. The production of NO is enhanced by shear stress during exercise, which leads to endothelial cell deformation and is influenced by the intensity of the exercise. Skeletal muscle activity during exercise promotes the formation and release of histamine, which plays an important role in vasodilation (Hayes et al., 2022). In addition, other factors such as weight loss, improved renal function, insulin sensitivity, and renin activity also contribute to the effect of increased physical activity on blood pressure (Ojangba et al., 2023; Solomon et al., 2023).

The American Heart Association (AHA) recommends that adults get at least 150-300 minutes/week of moderate-intensity aerobic activity 75-150 minutes/week of vigorous-intensity aerobic activity, or an equivalent combination of moderate- and vigorous-intensity activity (Barone Gibbs et al., 2021). A combination of moderate-to-vigorous aerobic physical activity and resistance training, performed at least three times a week, is most effective in lowering blood pressure (Hayes et al., 2022). Our study results showed that respondents with uncontrolled blood pressure engaged in vigorous physical activity (72.4%). These findings suggest that physical activity alone may not be sufficient to control blood pressure in hypertensive patients; other risk factors, such as poor diet, obesity, smoking, sleep duration, and comorbid conditions, influence the blood pressure response to physical activity (Modey Amoah et al., 2020; Pescatello et al., 2019).

The results of the study showed no significant relationship between BMI and blood pressure in hypertensive patients with a p-value of 0.594. This finding aligns with the research conducted by Nur et al. (2024), which demonstrated an absence of a significant relationship between BMI and the incidence of hypertension. Additionally, the research by Amelia et al. (2023) in 50 hypertensive patients indicated a very weak correlation (r = 0.197) between BMI and diastolic blood pressure in participants undergoing hypertension treatment. The findings of the study by Thapa et al (2022) in 245 adults in Nepal revealed no significant positive correlation between BMI and systolic and diastolic blood pressure.

In contrast, a study conducted at the Heart Polyclinic of Husada Utama Hospital, Surabaya, examined 85 respondents and found a relationship between BMI and blood pressure in individuals with hypertension (Sari et al., 2023). A person with obesity has a five-fold incidence of hypertension compared to those with a normal BMI (Shariq & McKenzie, 2020), but this study produced an insignificant relationship. The relationship between BMI and blood pressure appears weaker, possibly attributable to the increased use of antihypertensive medications among treated individuals compared to those not receiving treatment. An increase of 1 kg/m² in BMI has been associated with an increase in blood pressure ranging from 0.8 to 1.7 mmHg/(kg/m²), among individuals not receiving antihypertensive medications (Linderman et al., 2018).

This study also showed no significant relationship between BF% and blood pressure in hypertensive patients with a p-value of 0.559. This finding is consistent with the research of Ananta and Damayati at Kaliwates Health Center, Jember Regency, which showed no relationship between BF% and systolic and diastolic blood pressure in hypertensive patients (Ananta & Damayati, 2023).

Additionally, a very weak correlation was observed between BF% and blood pressure in women aged 35 to 54 in Dauh Puri Klod Village (Herinasari et al., 2022).

Conversely, a cross-sectional study conducted in a rural Chinese population found that BF% was significantly positively associated with the prevalence of hypertension in both men and women. In the male population, individuals with the highest BF% (≥27.9%) exhibited a 3.3-fold risk of hypertension compared to those with the lowest BF% (<21.2%), while in the female population, individuals with the highest BF% (≥36.9%) demonstrated a 2.6-fold risk of hypertension compared to those with the lowest BF% (<31.0%) (R. Li et al., 2020). This phenomenon may be attributed to the accumulation of adipose tissue in individuals with a high percentage of body fat (Shavela & Mariani, 2020), which is associated with adipocytokine production, inflammation, and insulin resistance (IR) (Zhou et al., 2024). Excessive fat accumulation leads to increased circulating free fatty acids, metabolic dysregulation, low-grade inflammation, and endothelial dysfunction (M. Li et al., 2022). Prolonged low-grade inflammation contributes to the initiation and development of essential hypertension (Z. Zhang et al., 2023). There is mounting evidence supporting the notion that chronic inflammation, induced by visceral fat accumulation, plays a pivotal role in the development of insulin resistance (IR). This inflammation, as evidenced by increased levels of resistin or tumor necrosis factor-α in tissue macrophages, activates inflammatory signaling pathways in surrounding insulin-targeting cells (adipocytes). These pathways release inflammatory factors that are directly implicated in the development of IR. IR contributes to the enhancement of the sympathetic nervous system by increasing anti-natriuretic hormones such as angiotensin II-aldosterone, and inflammatory or oxidative stress leads to increased blood pressure (Zhou et al., 2024).

BMI and BF% have been identified as instruments for measuring obesity, a condition that has been shown to increase the risk of developing hypertension, which is a major contributing factor to cardiovascular disease, stroke, and kidney disease (Hall et al., 2021). Previous research has compared nutritional status as determined by serum albumin (SA) levels, finding that individuals with normal body weight but poor nutritional status exhibit a significant increase in the risk of developing hypertension, particularly in adults. These findings suggest that the association between obesity and hypertension prognosis is influenced by nutritional status (H. Z. Zhang et al., 2023). However, the underlying mechanisms remain to be fully elucidated, necessitating further research to clarify the precise mechanisms involved.

CONCLUSION

Based on the research results, it was concluded that 66.3% of hypertensive patients had uncontrolled blood pressure. The analysis showed that the elderly group had a 2.81 times lower risk of having uncontrolled blood pressure than the productive age group. In addition, often eating junk food was associated with a 2.269-fold increased risk of uncontrolled blood pressure. In contrast, gender, coffee consumption, physical activity, BMI and BF% were found to be insignificant factors in blood pressure in hypertensive patients.

SUGGESTION

Comprehensive education of hypertensive patients, including both the productive age and elderly populations, is essential. This education should address weight management, not only in obese individuals but also in those with normal weight status. It is important to encourage the adoption of healthier diets and the avoidance of junk food.

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