mutiara medika
Jurnal Kedokteran dan Kesehatan

Mutiara Medika: Jurnal Kedokteran dan Kesehatan
http://journal.umy.ac.id/index.php/mm

Vol 21 No 2 Page 26-31, January 2021

Correlation between Body Mass Index to Hypertension in A Rural Area in East Java

Hubungan Indeks Massa Tubuh terhadap Hipertensi pada Sebuah Daerah Pedesaan di Jawa Timur

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DATA OF ARTICLE:
Received: 26 Oct 2020
Reviewed: 05 Nov 2020
Revised: 01 Dec 2020
Accepted: 05 Dec 2020

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DOI:
10.18196/mmjkk.v21i1.7385

TYPE OF ARTICLE:
Research

Abstract: Hypertension is one of the most common diseases in primary health facilities. Hypertension increasing problem in developed and developing countries is obesity which is a risk factor for metabolic disease. However, research related to these two diseases in rural areas is still limited. Therefore, this study focuses on the relationship between Body Mass Index (BMI) and blood pressure in rural areas. This type of research is an observational study with cross-sectional in the outpatient unit of Puskesmas Ngronggot for 1 month. Patient categories were included patients aged > 18 years with Systolic Blood Pressure (SBP) ≥140 or Diastolic Blood Pressure (DBP) ≥ 90 or a history of hypertension medication. The results were calculated using the Spearman correlation test. This study was followed by 201 participants with a distribution of 65.7% female and 34.3% male, and a median age of 59 years. Research shows that participants who are overweight and obese account for more than 60%. The results of the Spearman test showed that BMI had a statistically significant correlation with SBP (p=0.029), DBP (p=0.016), and Mean Arterial Pressure (MAP) (p=0.008). In conclusion, BMI has a positive correlation with blood pressure, and obesity is prevalent in rural population.
Keywords: hypertension; Body Mass Index; obesity; rural areas

Abstrak: Hipertensi merupakan salah satu penyakit paling banyak di fasilitas kesehatan primer. Selain hipertensi, masalah yang meningkat di negara maju dan berkembang adalah obesitas yang menjadi faktor risiko terhadap penyakit metabolik. Akan tetapi, penelitian terkait dua penyakit tersebut di daerah pedesaan masih sedikit. Oleh karena itu, penelitian ini fokus pada hubungan antara Indeks Massa Tubuh (IMT) dengan tekanan darah pada orang-orang di perdesaan. Jenis penelitian ini adalah penelitian observasi dengan *cross-sectional* di unit rawat jalan Puskesmas Ngronggot selama 1 bulan. Kategori pasien yaitu pasien inklusi berusia >18 tahun dengan tekanan darah sistol (TDS) ≥140 atau tekanan darah diastole (TDD) ≥90 atau adanya riwayat pengobatan hipertensi. Hasil dihitung menggunakan uji korelasi *Spearman*. Penelitian ini diikuti oleh 201 peserta dengan distribusi 65.7% perempuan dan 34.3% laki-laki, serta median usia 59 tahun. Penelitian menunjukkan bahwa peserta yang *overweight* dan obesitas berjumlah lebih dari 60%. Hasil uji *Spearman* menunjukkan bahwa IMT berkorelasi signifikan dengan TDS (p=0.029), TDD (p=0.016), dan MAP (p=0.008). Kesimpulan, IMT berkorelasi positif terhadap tekanan darah, dan obesitas ditemukan banyak di populasi daerah pedesaan.

Kata kunci: hipertensi; Indeks Massa Tubuh; obesitas; daerah pedesaan

INTRODUCTION

Hypertension is one of the most common encountered problems in primary health care.[1] Its prevalence has reached about 1 billion worldwide while it is also predicted that the number will get as high as 1.56 billion worldwide by 2025.[2,3] Hypertension is already known as the main contributing factor to stroke and heart disease. It also correlates with other diseases, including heart failure, impaired renal function, retinal haemorrhage, and peripheral vascular disease. Therefore, hypertension has yielded a mortality rate of 9.4 million per year worldwide.[3,4] Fortunately, this increasing prevalence could be treated and prevented by antihypertensive drugs, lifestyle modification and risk factor reduction. However, these approaches sometimes do not work because on the one hand, patients are apprehensive and incompliant on their therapy and its complication. On the other hand, clinicians need a better update on antihypertensive drugs. Additionally, modifiable risk factors such as smoking, and obesity are often forgotten. [1,5]

Obesity is another problem that has been massively increasing in developed and even more in developing countries. Obesity has also been recognized as a major contributing factor to metabolic diseases such as diabetes mellitus, dyslipidaemia, and hypertension.[6] Framingham studies found higher systole and diastole blood pressure in the overweight population compared to normal Body Mass Index (BMI) population, while decreased body weight will yield reduced blood pressure either systole or diastole.[6,7] It is also said that younger adults aged below 35 years old with a BMI of more than 30 kg/m^2 or obesity had five times higher risk of hypertension than normal BMI, while population below 55 years old also correlated positively.[6]

In recent years, studies had focused on more detailed factors, such as environmental factors and lifestyle factors that distinguish between the hypertension population that lived in the rural and urban areas.[8] These two areas have different characteristics that will also generate a different number of prevalence and risk factors in hypertension.[9] However, studies about this characteristic are still limited particularly its correlation between BMI and hypertension in Indonesia, where hypertension and rural areas are both quite prevalent.[10]

Therefore, this study aims to correlate between body mass index, one of the main contributing factors of metabolic disease, and hypertension in a rural area condition. We have a hypothesis that body mass index correlates with blood pressure in this population.

MATERIAL AND METHOD

This study was an observational analytic, cross-sectional, single-site study that aimed to investigate the association between body mass index and blood pressure in rural area populations. The study was performed from September 15th to October 15th 2019 in outpatients at Community Health Care of Ngronggot, Nganjuk, East Java, Indonesia. Participants in this study were all hypertension patients that come to the outpatient clinic of this community health care. Inclusion criteria including age above 18 years old, Systole Blood Pressure (SBP) ≥ 140 and/or Diastole Blood Pressure (DBP) ≥ 90, or with a history of routine consumption of the antihypertensive drug. Exclusion criteria include patients' refusal to be included in this study, patients did not want to be examined, or patients unable to be examined for either anthropometry data or blood pressure data.

Variable data that was used in this study are age, gender, SBP, DBP, body height, and body weight. Mean Arterial Pressure (MAP) was obtained by calculating [((2 x DBP) + SBP) / 3] in mmHg. Body mass index was obtained with calculation of body weight [kg] / (body height [m]).[2] Then, participants will be divided into four groups by their body mass index. Underweight for BMI < 18.5, normal for BMI 18.5 to 25, overweight for BMI 25 to 30, and obese for BMI more than 30.

The materials for this study are sphygmomanometer to measure blood pressure, stature meter to measure body height and scale for body weight. This study will be conducted for one time only for each patient without follow up.

For statistical analysis, data analyses were conducted using Statistical Package for Social Sciences (SPSS) v25.0 for Windows. Descriptive statistics were used to describe demographic data such as age, gender, body mass index, body mass index group, SBP, DBP, and MAP. Correlation between body mass index and SBP, DBP, and MAP was performed with the Spearman test. A *p*-value of less than 0.05 was considered statistically significant for the test.

This study was conducted with the approval from the ethical board and head of the community health centre of Ngronggot. Informed consent was obtained for every patient that agreed to participate in this study.

RESULTS

The study was performed from September 15th to October 15th 2019 in outpatients at Community Health Care of Ngronggot, Nganjuk, East Java, Indonesia. Participants in this study were all hypertension patients that come to the outpatient clinic of this community health care aged > 18 years old with hypertension. In this study, 201 participants met the criteria to be included in the study. For gender characterization, there were 132 (65.7%) female and 69 (34.3%) male participants, as shown in Table 1. According to BMI cutoffs recommended by WHO, the most prevalent status was overweight, which accounted for 85 (42.3%) patients, followed by normal BMI, obesity, and underweight, 75 (37.3%), 30 (18.4%), and 4 (2%) patients, respectively, as shown in Table 2. The median age of patients that participated in this study was 59 years old (ranged between 28 and 89).

For blood pressure, the research focused on SBP, DBP, and MAP. The mean and standard deviation for SBP was 159.85 (SD = 1.236), for DBP was 92.09 (SD = 0.748), and for MAP was 114.61 (SD = 0.778). Additionally, the mean BMI for our participants was 26.38 (SD = 5.132). These characteristics were summarized in Table 3.

The correlation using the Spearman rank-order test was used to investigate any association between BMI and SBP, DBP, and MAP. The result of the test showed that BMI was found to have a statistically significant association with all blood pressure parameters, including SBP (p = 0.029), MAP (p = 0.008), and DBP (0.016). All these correlations are summarized in Table 4.

Table 1. Distribution of Participants Based on Sex

Sex	Frequency	Percentage
Female	132	65.7 %
Male	69	34.3 %

Table 2. Distribution of Participants Besed on BMI Classification

BMI Class	Frequency	Percentage	Cumulative Percentage
Underweight	4	2.0 %	2 %
Normal	75	37.3 %	39.3 %
Overweight	85	42.3 %	81.6 %
Obese	37	18.4%	100 %

Table 3. The Mean of Blood Pressure and Body Mass Index

	Mean	Standard Deviation
Systole Blood Pressure	159.85	± 1.236
Diastole Blood Pressure	92.09	± 0.748
Mean Arterial Pressure	114.61	± 0.778
Body Mass Index	26.38	± 5.132

Table 4. Correlation between Body Mass Index and Blood Pressure Using Spearman Rank Test

	p	Correlation Coefficient
Systole Blood Pressure	0.029	0.154
Diastole Blood Pressure	0.016	0.170
Mean Arterial Pressure	0.008	0.188

DISCUSSION

This study was performed at the Community Health Center of Ngronggot, which located in Nganjuk, East Java a district where poverty was accounted for 60% of its society. Ngronggot itself, one of the sub-district in Nganjuk, East Java only has one primary health care which is our centre. In Ngronggot, it is noted that the prevalence of hypertension was found relatively high, about 80% of every examined blood pressure. While obesity, which was still an ignored problem health, was also found relatively high, about 25%.[11] Therefore, we found that Ngronggot is a rural sub-district that fitted to be studied.

In this study, we found that BMI has a positive correlation that was statistically significant even though it was not strong toward SBP, DBP, and MAP on our adult population. This finding is consistent with several studies that also showed that BMI had a positive correlation to hypertension. In Italia, Longevity Check-Up 7+ Study showed a similar result which is BMI has a positive association with hypertension and became a significant risk factor on both systole and diastole blood pressure.[12] As well as a study in China that included 8940 adults and showed obesity has a significant association towards not only hypertension but also dyslipidaemia and diabetes mellitus type 2.[13] In Japan, a study was conducted in a rural area, Shimane, found that a significant positive correlation between increased body mass index and severity of hypertension.[8] A study from Mali, a developing country in Africa, also showed that obesity and overweight were important risk factors because of their correlation towards hypertension severity and elevation of systole and diastole blood pressure.[14]

In overweight and obese individual, some factors may explain their association with hypertension. Increased body mass index will also increase body weight which will result in elevation of the total volume of body fluid and peripheral resistance (followed by hyperinsulinemia, cell membrane disruption, and hyperactivation of renin-angiotensin system).[13] Increased BMI also means that there is an accumulation of excessive body fat, which is a major risk factor in hypertension even though the exact mechanism has not been understood clearly. It is presumed that there is a role of inflammation process plays in hypertension that resulted from fat cells by being sensitive to lipolysis and produce higher inflammatory cytokines. If this process continues, it will not only progress to more severe hypertension but also result in end-organ damage. Additionally, increased adipose tissue will release various adipokines, which is associated with decreased nitrite oxide production, an important substance to control vascular tone and to suppress the proliferation of vascular smooth muscle.[12] In both obese and overweight cases, impaired renal pressure natriuresis also played a major role in hypertension. Increased body mass index will increase sodium reabsorption and disrupt renal pressure natriuresis so that it eventually will increase activation of the sympathetic nervous system and the renin-angiotensin system. In chronic obesity, there is also an alteration in kidney structure which will lead to loss of nephron function and further elevate arterial pressure.[15] In contrast, lowering blood weight will yield the opposite process by increased insulin sensitivity, demoted sympathetic nervous system activation, and the other processes which will finally lead to reduced blood pressure.[6]

In this study, the participants had more than 60% of excessive BMI (42.3% overweight and 18.4% obese), which highlighted that majority of hypertensive patients were overweight or obese. This fact was particularly important because this study was conducted in a rural area, a setting that obesity snowballs than urban areas.[16] The role of obesity in the rural areas has some differences compared to patients in urban areas such as lack of physical activity, a disparity of diet, socioeconomic level, and education level.[14] The other factor that is also very important is food consumption capacity is much more superior in rural areas compared to urban areas because of the different approaches of the health care system, urbanization, and modernization. It is the reason why it is essential to pay attention to obesity, especially in rural areas because of those factors mentioned above.[16]

This study had several advantages and aimed to investigate the association between BMI and hypertension in a rural area condition even though many of the hypertension studies focused on a new approach of therapy so that studies about hypertension and obesity in rural areas are very limited compared to urban areas. This study was also conducted in primary health care, which entirely represents majority of

the patients in rural area. However, our study also had several limitations. The nature of this study, which was cross-sectional, could not determine the causal relationship between hypertension and BMI. Besides, this study did not include control participants which could generate more substantial and more accurate statistical results. Then, although our study was conducted in primary health care of the area, we performed a passive approach which may be more accurate if it is an active approach. Last, our study was only focused on BMI factors related to hypertension, which did not rule out other factors that could influence hypertension.

CONCLUSION

This study has shown that not only excessive BMI has a positive correlation to the elevation of blood pressure, including SBP, DBP, and MAP, but also excessive BMI was quite prevalent in hypertensive population.

Acknowledgement

The authors thank the Dean of the Faculty of Medicine, Airlangga University, and the head of the Community Health Center of Ngronggot, Nganjuk, East Java.

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