

ORIGINAL ARTICLE

The Relationship between Body Mass Index and Blood Pressure Control in Hypertension Patients at the Sukawati I Community Health Center, Gianyar Regency

I Gede Ketut Deny Patmantha Putra Tjahyadi^{1*}, Anak Agung Gede Budhitresna², Dewa Ayu Agung Alit Suka Astini³

¹Student of the Faculty of Medicine and Health Sciences, Warmadewa University

²Department of Internal Medicine Specialist, Faculty of Medicine and Health Sciences, Warmadewa University

³Department of Anatomy-Histology, Faculty of Medicine and Health Sciences, Warmadewa University

ARTICLE INFO

Article history:

Received: June 25, 2023

Received in revised form:

September 29, 2024

Accepted:

October 19, 2024

Keywords:

Hypertension, BMI, Blood Pressure Control

*Correspondent Author:
denypatmanta@gmail.com

ABSTRACT

Background: Being overweight or obese is one of the factors that cause an increase in blood pressure. The bigger a person's body, the more blood is needed to supply nutrients and oxygen to other tissues and muscles. Bali Province, especially Gianyar Regency, has a relatively high number of hypertension sufferers. The highest estimate of hypertension sufferers is in the working area of the Sukawati I Public Health Center, with a prevalence of 8.55% of the total in Gianyar Regency of 17.35%. This research aims to determine the relationship between body mass index and blood pressure control in hypertensive patients at the Sukawati I Public Health Center, Gianyar Regency.

Methods: The research design used was analytic observational with a cross-sectional approach. The number of research subjects, namely 83 people, was taken by consecutive sampling technique. Data analysis will be carried out univariately and bivariate using the chi-square test method with a confidence level of 95% ($p < 0.05$).

Results: The results of the univariate analysis showed that the majority of study subjects were aged 51-60 years (60.2%), were female (66.3%), most had normal BMI (66.3%), and 66.3% of subjects with hypertension were classified as have controlled blood control. Based on the results of statistical tests, a value of $p = 0.003$ ($p < 0.05$) was obtained, which indicated a significant relationship between body mass index and blood pressure control in hypertensive patients at the Sukawati I Public Health Center, Gianyar Regency. **Conclusion:** The results of this study indicate that the increasing BMI status of hypertensive patients will tend to have uncontrolled blood pressure.

Introduction

Hypertension is a health problem that receives serious attention in every world. Hypertension is an important risk implication of cardiovascular diseases such as stroke, heart problems, kidney disease, and heart attacks⁽¹⁾. Based on data from the World Health Organization (WHO), it is estimated that 1.28 billion adults aged 30 to 79 years in several countries suffer from high blood pressure⁽¹⁾. Basic Health Research (Riskesdas) states that the high blood pressure level in Indonesia is 34.1%⁽²⁾. Riskesdas data for 2018 shows Bali Province has a hypertension prevalence rate of 30.97%. Data from Riskesdas for the Province of Bali in 2020 showed that Gianyar Regency had 89,603 cases of hypertension sufferers at the age of >15 years, but only 18,773 patients, or 21% received health services⁽³⁾. According to the Gianyar Regency health profile data for 2020, the highest incidence of hypertension is in the working areas of the Ubud I, Gianyar II, Sukawati II, and Sukawati I Health Centers⁽⁴⁾. The total estimation of hypertension sufferers in the working area of the Sukawati I Health Center is 10,872 people out of a total population of 127,050 people. In comparison, only 1,196 people have just received health services. The number of sufferers receiving this health service when compared to the public health centers with the other highest incidence of hypertension is still very far away. As a comparison, the working area of Ubud I, with the highest incidence of hypertension has an estimated number of hypertension sufferers of 4,811 people and those who have received health services totaling 3,160 people⁽⁴⁾. In this case, each working area of the public health centers must have an active role in

capturing and providing health services to people with hypertension because hypertension is classified as one of the top 10 diseases and ranks 2nd⁽⁴⁾.

Hypertension is a condition in the composition of the blood circulation which increases blood pressure above the standard limit, which is above 140/90 mmHg⁽⁵⁾. High blood pressure becomes very dangerous if the patient does not control blood pressure so that it is below 140/90 mmHg, because, in a long time it can cause various complications. The high incidence of hypertension is caused by risk factors that can be divided into two components: components that cannot be changed and those that can be changed. Components that cannot be altered consist of gender, race, age, and heredity. Components that can be changed include obesity, stress, smoking, lack of exercise, and hyperlipidemia⁽⁶⁾. The National Health and Nutrition Examination Survey III (NHANES III) says that the increase in hypertension in obese men is 42% and in women with obesity is 38%. Hypertension with obesity has a relationship as illustrated by increased plasma volume and cardiac output (output), hyperinsulinemia or insulin resistance, increased activity of sympathetic nerve structures, sodium retention, and dysregulation of salt regulating hormone. The blood that the body needs to carry nutrients and oxygen to all organs will increase with the increase in one's body size⁽⁶⁾. The assessment of whether a person is included in the obese category or not, which is often used is by using anthropometry. Anthropometric measurements consist of various methods, one of which is by measuring Body Mass Index (BMI)⁽⁷⁾. Previous research has suggested that there is a link between BMI and blood pressure in people with

hypertension, where respondents with obesity are more likely to have hypertension (91.3%) than non-obese respondents who have hypertension (58.2%)(8). The results of other studies also convey that a high prevalence rate of obesity will increase the prevalence rate of hypertension. In contrast, other studies suggest that there is no relevant link between BMI and the incidence of hypertension⁽⁹⁾. Based on the background above, researchers are very interested in getting the answer by carrying out scientific evidence through a study that focuses on finding out whether there is a relationship between body mass index and blood pressure control in hypertension sufferers who are at the Sukawati I Health Center, Gianyar Regency, Bali.

Methods

The method used in this study is an analytic observational survey with a cross-sectional method. This research was conducted at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency from August to November 2022. The population was high blood pressure sufferers aged 18-60 years who routinely came for control and the number of samples taken was 83 people who met the criteria set has been determined. The primary data measured were blood pressure, weight, and height. The instrument used to measure blood pressure control utilizes a mercury tension meter with the Riester brand. Weight measurement uses a digital weight scale with the Onemed brand and a stature meter with the Onemed brand for height measurements. Furthermore, the data will be analyzed using the Chi-Square test with the SPSS program. This research was approved based on an ethical clearance letter from Udayana University issued on October 27, 2022.

Results

Characteristics of Respondents

Based on the research that has been done, it shows that the sufferers of high blood pressure at the Sukawati I Health Center, Sukawati District, Gianyar Regency mainly occur in the female sex, namely 55 people (66.3%). The age distribution of the study subjects showed that high blood pressure sufferers at the Sukawati I Health Center, Sukawati District, Gianyar Regency mostly occurred in the age range of 51-60 years, namely 50 people (60.2%).

Table 1. Distribution of Gender and Age of Study Subjects

Variable	Total (n), (%)
Gender	
Man	28 (33,7)
Woman	55 (66,7)
Age	
18-30 Years	2 (2,4)
31-40 Years	6 (7,2)
41-50 Years	25 (30,1)
51-60 Years	50 (60,2)

Source: Research Data, 2022

The distribution of the study subjects' body mass index showed that most people with high blood pressure at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency had a normal BMI, namely 55 people (66.3%).

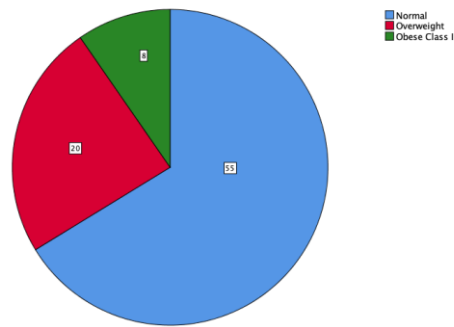


Figure 1. Distribution of Body Mass Index of Study Subjects

The distribution of blood pressure control in the study subjects showed that 55 people (66.3%) had controlled blood pressure at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency.

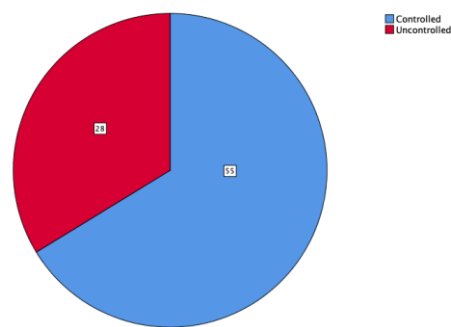


Figure 2. Distribution of Blood Pressure Control of Study Subjects

Correlation Test Between Body Mass Index And Blood Pressure Control

Based on the analysis that has been done, it shows that most of the study subjects with normal body mass index have controlled blood pressure, namely 40 people (72.7%). Most study subjects with overweight body mass index had controlled blood pressure, namely 14 people (70%). While study subjects with obesity body mass index I mostly had uncontrolled blood pressure, namely seven people (87.5%).

Based on the analysis that has been carried out, a p-value of 0.003 is significant at the 95% confidence level, which is substantial or there is a relationship

between body mass index and blood pressure control in hypertension sufferers at the Sukawati I Health Center, Gianyar Regency. Hypertensive patients with obesity body mass index status tend to have uncontrolled blood pressure compared to hypertensive patients with normal body mass index status and are overweight.

Table 2. Correlation Test Between Body Mass Index and Blood Pressure Control

BMI	Hypertension		p
	Controlled n (%)	Uncontrolled n (%)	
Normal	40 (72,7)	15 (27,3)	0,003 *
Overweight	14 (70)	6 (30)	
Obese class I	1 (12,5)	7 (87,5)	

*statistically meaningful

Discussion

Prevalence Of Controlled And Uncontrolled Hypertension

Based on the research that has been done, it shows that the prevalence of blood pressure control in people with high blood pressure at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency has controlled blood pressure, namely 55 people (66.3%).

This is in line with research conducted by Almira in 2013. In this study, out of 128 respondents, it was found that the number of respondents who had controlled blood pressure was more than those who had uncontrolled blood pressure. This is caused by respondents who have paid attention to a healthier lifestyle in terms of food intake, physical activity, not smoking, and taking antihypertensive drugs regularly. This dramatically impacts blood pressure

in people with hypertension because many other factors can affect blood pressure, such as salt intake, level of stress experienced, physical activity, and body mass index⁽¹⁰⁾.

This study is also in line with research conducted by Jayanti et al. in 2013, which found that more people with hypertension have controlled blood pressure. This is caused by increased patient knowledge about the various causes and risk factors for hypertension, which indirectly impact better behavior in controlling blood pressure so that blood pressure remains under control. Patient knowledge about hypertension also affects patient adherence in carrying out treatment. Patients with good knowledge about hypertension will adhere to treatment, where treatment is an essential factor in controlling blood pressure in people with hypertension. Along with increasing knowledge about hypertension, people with hypertension can better manage their condition so that sufferers have controlled blood pressure⁽¹¹⁾.

Research conducted by Awan in 2018 also found that the average hypertension sufferer has controlled blood pressure. Most of the respondents in Awan's study had an age range of 46-55 years (37.23%). The older a person is, the wiser they are in making decisions, the more experience they gain, and the more things they do so that they increase their knowledge, especially information about the condition of hypertension. Age affects one's mindset, and mindset influences one's behavior. Age will be an indicator in every decision that refers to each experience⁽¹²⁾.

This differs from research by Budi and Mahalul in 2016, which found that people with hypertension tend to have uncontrolled blood pressure. This can be caused by the habit of people with hypertension

who consume coffee and salt. Coffee contains caffeine which has a competitive antagonistic effect on adenosine receptors. Adenosine is a neuromodulator that influences several functions in the central nervous system. This impacts vasoconstriction and increases total peripheral resistance, increasing blood pressure. Excessive salt consumption causes a buildup of fluid in the body because it will attract fluids outside the cells so they don't come out, increasing blood volume and pressure⁽¹³⁾.

Donghao et al. also obtained a different study in 2018. In this study, it was found that hypertension sufferers had uncontrolled blood pressure. This study found that hypertensive patients who had taken medication but did not control their blood pressure had an increased risk of all causes and death from Cardiovascular Disease (CVD) compared to normotensive adults. The results of this study are related to several risk factors. High-risk factors with the majority of subjects in this group is found to be older, black race, obesity, diabetes, and low educational status. Patient non-adherence to hypertension drugs (for example, inadequate doses or wrong types of antihypertensive medications) can also increase the risk of death in hypertensive patients undergoing treatment but with uncontrolled blood pressure⁽¹⁴⁾.

Body Mass Index Of Hypertension Patients

In this study, the distribution of the body mass index of the research subjects showed that most of the people with high blood pressure at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency had a normal BMI, namely 55 people (66.3%).

This research is supported by Yoel et al. in 2017, which found that hypertension sufferers based on

BMI were in the normal category. This can be caused by less physical activity. Lack of physical activity is a risk factor for hypertension. People with less physical activity tend to have a higher heart rate, so the heart muscle must work harder with each contraction. The stronger and more frequently the heart muscle pumps, the greater the pressure on the arteries⁽¹⁵⁾.

This is also supported by research conducted by Angelia in 2019 which found that people with hypertension tend to have normal BMI status. Patients with hypertension are not only influenced by BMI status but can also be influenced by other factors such as age. With the increasing age of a person, the incidence of high blood pressure (hypertension) will be higher. This is because in old age, there are structural and functional changes in the peripheral vascular system, which are responsible for changes in blood pressure that occur in old age⁽¹⁶⁾.

A different study was obtained by Agnes and Evelin in 2020, which found that more people with hypertension were in the obese BMI category. Obesity results in increased deposition of fatty acids in the heart muscle, which impacts left ventricular dysfunction and changes the hormone regulatory system, namely the renin-angiotensin system. This results in salt retention and increased blood pressure. Apart from body fat in general, the accumulation of abdominal fat (high waist circumference) is a cause of hypertension⁽¹⁷⁾.

A different thing was also found by Ikhyia et al. in 2018 most hypertension sufferers were in the obesity category. There is a role in the inflammatory process in hypertension, which is produced from fat cells, which causes them to become sensitive to lipolysis and have higher levels

of inflammatory cytokines. If this process continues, it will develop into more severe hypertension and result in end-organ damage⁽¹⁸⁾.

The Relationship Between Body Mass Index And Blood Pressure Control

According to the bivariate analysis using the Chi-Square test with a p-value of 0.003 it means that at the 95% confidence level it is stated to be significant or it means that there is a relationship between body mass index and blood pressure control in hypertension sufferers at the Sukawati I Health Center, Gianyar Regency. Body mass index has a significant impact on the incidence of hypertension. An increase in BMI value will be followed by a rise in blood pressure, which indicates that the higher a person's BMI value, the higher the chance of developing hypertension⁽¹⁹⁾.

In this study, respondents who were obese tended to have uncontrolled blood pressure. This aligns with research by Ebrahim and Smith, who tested eight experimental people who were examined to see the effect of weight loss on blood pressure. After experimenting, it was concluded that weight gain is associated with increased blood pressure. Meanwhile, weight loss results in a decrease in blood pressure. The reduction in blood pressure was in the range of 5.2 mmHg both systolic and diastolic for various levels of weight loss⁽¹⁹⁾.

A study conducted by Hammami et al. found that patients with uncontrolled blood pressure tend to be obese and have a higher BMI. Among patients who are overweight or obese, there is a correlation between the prevalence of uncontrolled blood pressure and the severity of obesity (71.5% in overweight people, 74.8% in moderately obese patients, and 79.4% in severely obese patients)⁽²⁰⁾.

Research conducted by Erika Maryani et al. also found that people with hypertension tend to be obese. The results showed that out of 84 respondents, 47 respondents were obese, 30 of them suffered from hypertension and 17 respondents did not suffer from hypertension. Meanwhile, of the 37 respondents who were not obese, 12 of them suffered from hypertension and 25 respondents did not suffer from hypertension. This research also aligns with Hasanah et al. which states that hypertension and obesity are interconnected because the more extensive a person's body, the more blood is needed to supply oxygen and nutrients to body tissues. The leading causes of hypertension in obesity are related to increased body volume, cardiac output, and decreased systemic vascular resistance⁽²⁰⁾.

Being overweight and obese are one of the characteristics of people with hypertension. Heart function in people with obesity conditions must work harder to pump blood throughout the body. Losing weight strongly correlates with reducing blood pressure in obese individuals. The pumping power of the heart and circulation of blood volume in obese patients with hypertension is higher than in hypertensive patients with average weight. The pathophysiology focuses on three main things: autonomic disorders, insulin resistance, and structural and functional abnormalities of blood vessels⁽⁸⁾.

This differs from a study by Almira which found no relationship between blood pressure control and body mass index in hypertension sufferers. Based on the theory, body mass index is related to hypertension, but other factors impact increasing blood pressure. BMI status has no relationship with the incidence of hypertension caused by other

influencing factors such as sodium intake. Respondents have normal BMI but have excessive sodium intake, which can cause blood pressure to increase⁽¹⁰⁾. Research conducted by Kaizhi et al. also found something different, namely that there was no relationship between BMI and hypertension. People with obesity are more willing to have their physical condition checked so that the disease can be detected and treated earlier, and they are also more compliant with doctors' treatment plans. The increase in the sympathetic system is also in line with the results of cross-tabulations between obesity and stress events, namely it was found that stress events were more common in older adults who were not obese. Sympathetic nerve activity that regulates nerve and hormone function can cause an increase in heart rate, narrowing of the arteries and increased retention of water and sodium⁽¹⁰⁾.

Conclusion

Based on the analysis and discussion above, it can be concluded that most hypertension sufferers at the Sukawati I Public Health Center, Sukawati District, Gianyar Regency, have controlled blood pressure and a normal BMI. There is a relationship between body mass index and blood pressure control in hypertensive patients at the Sukawati I Public Health Center, Gianyar Regency. Hypertensive patients with obesity body mass index status tend to have uncontrolled blood pressure compared to hypertensive patients with normal body mass index status and are overweight.

Conflict of Interest

No conflict of interest in this study

References

1. WHO. Hypertension [Internet]. 2021. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>
2. Kementerian Kesehatan RI. Hasil Riset Kesehatan Dasar Tahun 2018. Kementrian Kesehat RI. 2018;53(9):1689–99.
3. Dinas Kesehatan Provinsi Bali 2020. PROFIL KESEHATAN DINAS KESEHATAN PROVINSI BALI 2020. Kesehat Provinsi Bali 2020. 2020;3:103–11.
4. Dinas Kesehatan Kabupaten Gianyar. Profil Kesehatan Gianyar Tahun 2020. 2020; Available from: <https://diskes.baliprov.go.id/download/profil-kesehatan-gianyar-2020/>
5. Kementerian Kesehatan RI. Hipertensi Si Pembunuh Senyap. Kementrian Kesehat RI [Internet]. 2019;1–5. Available from: <https://pusdatin.kemkes.go.id/resources/download/pusdatin/infodatin/infodatin-hipertensi-si-pembunuh-senyap.pdf>
6. Sarumaha EK, Diana VE. Faktor Risiko Kejadian Hipertensi Pada Usia Dewasa Muda di UPTD Puskesmas Perawatan Plus Teluk Dalam Kabupaten Nias Selatan. J Kesehat Glob. 2018;1(2):70.
7. Supariasa. Penilaian Status Gizi (Edisi Revisi). Jakarta: Penerbit Buku Kedokteran EGC; 2013.
8. Ramadhan MD, Masyitah D, Syauqy A, Penyakit B. Hubungan indeks massa tubuh dengan tekanan darah pada penderita hipertensi di poliklinik penyakit dalam rumah sakit umum daerah raden mattaher jambi tahun 2015. 2015;10(20):1–7.
9. Suangga GI. Hubungan Indeks Massa Tubuh Dengan Hipertensi Di Rumah Sakit Pendidikan Universitas Hasanuddin. J Med. 2017;1–77.
10. Ramadhani AD. Hubungan Kontrol Tekanan Darah dengan Indeks Massa Tubuh pada Pasien Hipertensi. 2013;64.
11. Wulansari J, Ichsan B, Usdiana D. Hubungan Pengetahuan Tentang Hipertensi Dengan Pengendalian Tekanan Darah Pada Pasien Hipertensi Di Poliklinik Penyakit Dalam Rsud Dr.Moewardi Surakarta. Biomedika. 2013;5(1):17–22.
12. Dramawan A. Kepatuhan Keperawatan Dengan Tekanan Darah Terkontrol Pada Pasien Hipertensi. J Keperawatan. 2018;53(9):1689–99.
13. Artiyaningrum B. Faktor-faktor yang Berhubungan dengan Kejadian Hipertensi Tidak Terkendali pada Penderita yang Melakukan Pemeriksaan Rutin. J Perspekt Kesehat Masy. 2016;1(1):12–20.
14. Zhou D, Xi B, Zhao M, Wang L, Veeranki SP. Uncontrolled hypertension increases risk of all-cause and cardiovascular disease mortality in US adults: The NHANES III Linked Mortality Study. Sci Rep. 2018;8(1):1–7.
15. Abaa YP, Polii H, Wowor PM. Gambaran Tekanan Darah, Indeks Massa Tubuh, dan Aktivitas Fisik pada Mahasiswa Kedokteran Umum Angkatan Tahun 2014. J e-Biomedik. 2017;5(2).
16. Azri Hazwan, Gde Ngurah Indraguna Pinatih. Gambaran Karakteristik penderita

- hipertensi dan tingkat kepatuhan minum obat di wilayah kerja puskesmas kintamani I. Intisari Sains Medis [Internet]. 2017;8(2):130–4. Available from: <http://isainsmedis.id/>
17. Ulumuddin I, Yhuwono Y. Hubungan indeks massa tubuh dengan tekanan darah pada lansia di desa pesucen, banyuwangi. *J Kesehat Masy Indones*. 2018;13(1):2018.
 18. Kurniawan AH, Suwandi BH, Prakoso DT, Moksidy RC, Talitha I, Anggraeni MK, et al. Correlation between Body Mass Index to Hypertension in A Rural Area in East Java. *Mutiara Med J Kedokt dan Kesehat*. 2021;21(1):26–31.
 19. Harsha DW, Bray GA. Weight Loss and Blood Pressure Control (Pro). *Hypertension*. 2008;51(6):1420–5.
 20. Hammami R, Bahloul A, Triki S, Charfeddine S, Triki F, Zakhama L, et al. Impact of Overweight and Obesity on Blood Pressure Control Among Hypertensive Patients (Results From Nature Htn). *J Hypertens*. 2021;39(Supplement 1):e339.