Jurnal Ilmiah Ners Indonesia
https://doi.org/10.22437/jini.v5i2.36305
Volume 5, Issue 2, November 2024, p. 101-109

p-ISSN: 2722-922x
e-ISSN: 2722-9211

Validity of Blood Pressure Measurement in Hypertention Patients

[1*]Diah Merdekawati, [2]Dasuki, [3]Aguspairi
[1,2]Sekolah Tinggi Ilmu Kesehatan Harapan Ibu Jambi
[3]Universitas Adiwangsa Jambi
E-mail: zelyyeliva@gmail.com

Received: 23 July 2024; Revised: 25 October 2024; Accepted: 27 November 2024

ABSTRACT

Hypertension is abnormal blood pressure and should measure more than once. Precise blood pressure measurements will produce valid data. This research aims to determine the validity of blood pressure in hypertensive patients. The method is quantitative with a cross-sectional research design, accidental sampling technique on 153 respondents, at the Rawasari Community Health Center, Jambi City, and the kappa test is used to statistical test. The validity of the measurement uses accuracy, specificity, and sensitivity tests. The results obtained were 66% of respondents with degree 1 hypertension on the right arm and 58.8% on the left arm. Blood pressure in the right arm correlates with blood pressure in the left arm and vice versa with values of p = 0.000. The sensitivity value is 73.2%, the specificity value is 88.7%, and the accuracy value is 83%. But the left arm has a sensitivity value of 78.8%, a specificity value of 85.1%, and an accuracy value of 83%. Blood pressure measurement on the right arm is more valid than the left arm because it has a higher specificity and positive predictive value and has a higher LR+ value. The conclusion is that the right arm is better for measuring blood pressure, because it has a greater specificity value which influences the choice of measurement location.

Keywords: Blood Pressure, Left and Right Arms, Hypertension

INTRODUCTION

More than 36 million people die every year due to non-communicable diseases (NCDs). There are 9 million deaths caused by non-communicable diseases, before the age of 60 years. These premature deaths occur in countries with lower middle income. Around 45% of deaths are due to complications of hypertension, namely heart disease and as many as 51% of deaths are due to stroke. Several cardiovascular diseases result in death, namely coronary heart disease and stroke, which are expected to continue to increase to 23.3 million in 2030 (Indonesian Ministry of Health, 2014). The 2018 National Basic Health Research obtained data on the prevalence of hypertension in Indonesia based on age ≥18 years of 34.1% and an increase from 2013 of 8.3% (Indonesian Ministry of Health, 2018).

Data from the Jambi Provincial Health Service shows that in 2016 the prevalence rate of hypertension in Jambi Province reached 7,972 people, while in 2017 there was an increase in the prevalence rate of hypertension in Jambi Province to 9,456 people (Jambi City Health Office, 2018). Hypertension sufferers based on data from the Jambi City Health Service in 2018, in all Jambi City Health Promotion Center working areas, the highest number of hypertension sufferers were in the Rawasari Health Promotion Center working area, Kota Baru District, Jambi City with 4,846 sufferers, while the lowest number of hypertension sufferers were in the Paal Health Promotion Center I working area, namely 379 people suffering from hypertension.

Silent killer is a term for hypertension, because it is one of the causes of mortality and morbidity in Indonesia, so it is very common for interventions to be carried out at various levels of health facilities. All major guidelines both from within and outside the country state that a person suffers from hypertension if the results of a systolic blood pressure examination are ≥ 140 mmHg and/or diastolic ≥ 90 mmHg and the examination is carried out repeatedly. The basis for determining the diagnosis of hypertension is determined by the results of systolic blood pressure (PERKI, 2015).

Blood pressure measurement begins by placing the cuff tightly and gently on the upper arm, then expanding it by pumping until the radial or brachial pulse disappears. Continue by inflating the cuff by 20 to 30 mmHg after the radial pulse has disappeared. The systolic blood pressure has passed and the brachial artery has closed which is the cause of the loss of pulsation. Next, slowly deflate the cuff and take a reading by auscultation or palpation. Systolic pressure can be measured by palpation, while through auscultation the systolic and diastolic pressure can be measured more accurately (Smeltzer and Bare 2013).

Early detection will help determine management and efforts to prevent damage or disability. Correct diagnosis of hypertension can be done by measuring blood pressure. The diagnosis of hypertension can be determined by measuring blood pressure twice with a diastolic pressure of 90 mmHg or more and a systolic pressure of more than 135 mmHg. Some literature states that it is important to measure blood pressure in both arms (Potter and Perry, 2013).

Assa et al., 2014 research compared blood pressure in the left and right arms of hypertension sufferers with the results of differences in blood pressure in the left and right arms of hypertension sufferers.[6]Blood pressure measurements are generally carried out on the right arm, but not on that arm if it is injured. Blood pressure is best measured at rest and in a sitting or lying position. This is because blood pressure is influenced by many factors, namely cardiac output, peripheral vascular resistance, arterial elasticity, and blood volume (Potter and Perry, 2013).

Based on the background above, this research aims to obtain the validity value of blood pressure measurements for hypertension sufferers by comparing the results of sensitivity, specificity and accuracy measurements.

METHOD

This research design was quantitative with methods *crosssectional.* The aim of the research is to determine the validity of the blood pressure measurement results of hypertensive sufferers. Inclusion criteria included hypertension sufferers who were willing to take part in the research, adults aged 26-45 years and diagnosed with hypertension by a doctor. The exclusion criteria in this study were women suffering from hypertension who were pregnant, suffering from hand and arm disabilities, in the elderly category and unconscious.

This research was carried out at the Rawasari Community Health Promotion Center, Jambi City, in the General Poly Room. The research sample was 153 respondents using the technique *accidental sampling* for 3 months. Each respondent had blood pressure measured on both the left and right arms 3 times in a sitting position and with a time difference of 5 minutes for each measurement. The digital blood pressure meter used has been calibrated, thereby reducing bias in blood pressure measurements. The measurement results will be analyzed using the

lowest value in statistical tests, namely the kappa test, sensitivity test, specificity test and accuracy test.

RESULT

1. The characteristics of the respondents

The characteristics of the respondents obtained were gender and occupation. Details can be seen in the table below:

Table 1. Frequency Distribution of Respondents Based on Gender and Occupation (n=153)

Characteristics	n	%
Gender		
Male	45	29,4
Female	108	70,6
Occupation		
Without work	58	37,9
Civil Servant	23	15
Private	72	47,1

Table 1 showed that the gender of the respondents was 70.6% female and 47.1% of the respondents worked in the private sector.

2. Univariat Analysis

The results of the data analysis that has been carried out show that hypertensive sufferers have different degrees of hypertension when blood pressure is measured on both the right and left arms. Details are in the table below:

Table 2. Frequency Distribution of Respondents' Blood Pressure Based on Degree of Hypertension (n=153)

Hypertension Stage	n	%
Right arm		
Not Hypertension	10	6,5
Pre Hypertension	42	27,5
Stage 1	101	66
Left arm		
Not Hypertension	1	0,6
Pre Hypertension	55	34,8
Stage 1	90	58,8
Stage 2	9	5,8

Table 2 showed that more than half of the respondents experienced grade 1 hypertension in the right arm (66%) and left arm (58.8%). Next, the data was analyzed into a 2x2 table, by categorizing into no hypertension and hypertension, the data in the table below:

Table 3. Frequency Distribution of Respondents' Blood Pressure (n=153)

Hypertension Degrees	n	%
Right arm		
Not hypertension	52	34
Hypertension	101	66
Left arm		
Not hypertension	56	36,6
Hypertension	97	63,4

From the table above it is known that the majority of respondents were categorized as having hypertension in the right arm (66%) and left arm (53.4%).

3. Bivariat Analysis

The results of the analysis in the table below consist of the results of blood pressure measurements in hypertension sufferers in both arms, namely:

Table 4. Respondent's Blood Pressure on the Right Arm (n=153)

		Left Arm		Total	Significancy
Right Arm		Hypertension	Not hypertension		
	Hypertension	41	11	52	0,000
	Not hypertension	15	86	101	
	Total	56	97	153	

Sensitivity : $\frac{a}{a+c} = \frac{41}{41+15} = \frac{41}{56} = 73,2\%$

Specificity : $\frac{d}{b+d} = \frac{86}{11+86} = \frac{86}{97} = 88,7\%$

Positive predictive value: $\frac{a}{a+b} = \frac{41}{41+11} = \frac{41}{52} = 78,8\%$

Negative predictive value:$\frac{d}{c+d} = \frac{86}{15+86} = \frac{86}{101} = 85,1\%$

Accuracy : $\frac{a+d}{a+b+c+d} = \frac{41+86}{41+11+15+86} = \frac{127}{153} = 83\%$

Likelihood Ratio positive (LR+) : $\frac{Sensitifity}{(1-Specifity)} = \frac{73,2\%}{1-88,7\%} = 663,6\%$

Likelihood Ratio negative (LR-) : $\frac{(1-Sensitifity)}{Specifity} = \frac{(1-73,2\%)}{88,7\%} = 30,3\%$

Based on the analysis above, it is known that there is a correlation between blood pressure in the right and left arms (0.000). Apart from that, it is known that the right arm has a sensitivity value of 73.2%, a specificity value of 88.7% and an accuracy value of 83%. However, blood pressure in the left arm can be seen in detail as follows:

Table 5. Respondent's Blood Pressure on the Left Arm (n=153)

		Right Arm		Total	Significancy
Left Arm		Hypertension	Not hypertension		
	Hypertension	41	15	56	0,000
	Not hypertension	11	86	97	
	Total	52	97	153	

Sensitivity : $\frac{a}{a+c} = \frac{41}{41+11} = \frac{41}{52} = 78,8\%$

Specificity : $\frac{d}{b+d} = \frac{86}{15+86} = \frac{86}{101} = 85,1\%$

Positive predictive value:: $\frac{a}{a+b} = \frac{41}{41+15} = \frac{41}{56} = 73,2\%$

Negative predictive value:$\frac{d}{c+d} = \frac{86}{11+86} = \frac{86}{97} = 88,6\%$

Accuracy : $\frac{a+d}{a+b+c+d} = \frac{41+86}{41+15+11+86} = \frac{127}{153} = 83\%$

Likelihood Ratio positive (LR+) : $\frac{Sensitifity}{(1-Specifity)} = \frac{78,8\%}{1-85,1\%} = 526,7\%$

Likelihood Ratio negative (LR-) : $\frac{(1-Sensitifity)}{Specifity} = \frac{(1-78,8\%)}{85,1\%} = 24,7\%$

Based on the analysis above, it is known that there is a correlation between blood pressure in the left arm and the right arm (0.000). Apart from that, it is known that the left arm has a sensitivity value of 78.8%, a specificity value of 85.1% and an accuracy value of 83%.

Based on the LR+ and LR- values, it can be concluded that blood pressure measurements on the right arm are more valid compared to the left arm, which is characterized by higher specificity and positive predictive values and has a higher LR+ value.

DISCUSSION

Hypertension is blood pressure above normal values continuously. In asymptomatic conditions (without clear symptoms) and is often a contributing factor to myocardial infarction (heart attack). An increase in blood pressure without a known cause is called *primary hypertension*. An increase in blood pressure that has a known cause is called *secondary hypertension*. Hypertension is a widespread health problem. Systolic blood pressure greater than 130mmHg or diastolic blood pressure greater than 85mmHg (Kozier and Erbs, 2010).

The research data obtained showed that there were more types of respondents female gender of man. Previous theories explain the influence of type gender on the incidence of hypertension, Men are more at risk of experiencing an increase in systolic blood pressure than women. However, the prevalence of hypertension in women increases after experiencing menopause. The hormones estrogen and progesterone can increases the angiotensin II pressor response through the RAAS pathway, resulting in an increase blood pressure (Putri, et al, 2015). The research results were strengthened by Khasanah et al. (2020) through the results of their research, namely that the majority (76.5%) of hypertension sufferers were women. Research by Rosadi & Hildawati (2021) also states that 80.7% of hypertension sufferers are female.

Physical activity can affect blood pressure, when you are active your blood pressure becomes higher, whereas when you are active resting will be lower. Regularity in doing physical activity can reduce it blood vessel stiffness as well increase the endurance of the heart and lungs, so that blood pressure drops (Suryani, et al, 2020). This is in line with research results which found that the majority of respondents worked and therefore carried out routine activities.

Eliani et al. (2022) through their research found that there is a relationship between daily activities and the degree of hypertension. A total of 59.4% of

respondents experienced grade 1 hypertension. Research findings also show that the majority of respondents experienced grade 1 hypertension. In line with Purqoti and Ningsih, (2019) research results, 66.7% of respondents experienced hypertension stage 1.

Blood pressure is the pressure produced by blood in blood vessels and is in accordance with blood volume and flexibility of blood vessels. An increase in blood pressure is caused by an increase in blood volume or the flexibility of blood vessels, while a reduction in blood volume can reduce blood pressure (Setiawan and Sari, 2010). The factor that influences the difference in pressure in the blood vessels is body position, then changes in blood pressure according to body position are influenced by the gravity factor (Barbeau, 2004).

Accurate blood pressure measurement is very useful for clinical decisions. Accurate blood pressure measurement is also useful for diagnosing and managing hypertension. Besides that, the use of validated and calibrated devices is essential to obtain accurate blood pressure measurement results (Frese, et al, 2011). Likewise, this research uses a digital sphygmomanometer which has been calibrated so that the data obtained is valid. According to Putra in 2021, the digital sphygmomanometer has a sensitivity value of 90.6%, specificity 100%, PPV 100% and NPV 87.2%. The analysis results do not differ from the validity value *sphygmomanometer* mercury which is *gold standard* in measuring hypertension (Muntner et al., 2019).

In addition, blood pressure was measured in this study in a sitting position. In line with research by Jatinugroho & Lontoh (2021) which states that there is a significant difference in blood pressure in standing and sitting positions, but there is no difference in blood pressure in sitting and lying positions. Research by Menembu, et al., (2015) also concludes the position Sitting and standing when measuring blood pressure affects the systolic and diastolic values. Blood pressure in a standing position is higher than blood pressure in a sitting position.

Blood pressure checks were carried out on The client sits quietly in a chair with back support, both feet flat on the floor (Chobanian et al., 2003). This was done 5 minutes before the blood pressure measurement and both arms had to be measured. Blood pressure measurements in the standing position are carried out in patients who are at risk of developing postural hypotension (Pickering et al., 2005). In order to reduce bias, this study also took measurements on both arms 3 times and at an interval of 5 minutes for each measurement.

The results of the research analysis show that blood pressure in the right and left arms is related to each other, but has different validity values. This can be seen in the different values of sensitivity, specificity, accuracy, LR+ and LR-. The results of the analysis concluded that the right arm was better for measuring blood pressure compared to the left arm. The right arm has a higher specificity value, positive predictive value and LR+ compared to the left arm.

Essa and Ahmed (2022) have concluded the results of their research, namely that blood pressure measurements were carried out on both arms and in a sitting position accompanied by a stable condition. In addition, blood pressure measurements carried out on the dominant hand are better. Based on research findings, most of the right arm is the dominant arm for respondents and also has better validity values. Research findings were that 144 (94.2%) respondents had the right arm as their dominant arm.

Clark, et al. (2022) also stated that both arms should be measured to diagnose and manage hypertension. Good blood pressure measurements are carried out on the arm with high blood pressure. In contrast to the research findings, namely higher blood pressure in the left arm, this is due to a lack of activity carried out on the left arm. Statistically it has also been proven by validity results showing that the right arm is better used for measuring blood pressure.

Research by Robert et al. (2019) proves that the combined value of sensitivity and specificity in systole and diastole is good, but there is a bias towards male gender and respondents who do not work. This can be used as comparative data in research with a minority of respondents who are male and do not work, so that the bias in the measurement results is minimal.

CONCLUSION

Blood pressure measurements for hypertensive sufferers on the right arm are more valid with greater specificity, positive predictive value and LR+ compared to blood pressure on the left arm.

REFERENCES

Assa C, Rondonuwu R, Bidjuni H,. (2014) Comparison of Blood Pressure Measurements in the Left Arm and Right Arm in Hypertension Patients in the IRINA C BLU Room, Prof. Hospital. Dr. R.D. Kandou. Manado. Journal of Nursing: 2(2).

Association of Indonesian Cardiovascular Specialists (PERKI). (2015). Guidelines for Management of Hypertension in Cardiovascular Disease. Jakarta.

Barbeau TR. (2004). Cardiovascular physiology. Florence: Francis Marion University.

Chobanian AV, Bakris GL, Black HR, et al. (2003). The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. PEOPLE: 289(19).

Clark, E. C., Warren, F. C., Boddy, K., McDonagh, S. T.J. , Moore, S. F. Maria Teresa Alzamora, Rafel Blanes, R., Chuang, S. Y., Criqui, M. H., Dahl, M., Engström, G., Erbel, R., Espeland, M., Ferrucci, L, Guerchet, M., Hattersley, A., Lahoz, C., McClelland, R. L., McDermott, M. M., Price, J., Stoffers, H.E., Wang, J. G., Westerink, J., White, J., Cloutier, L., Taylor, R. S., Shore, A. C., McManus, R., J., Aboyans, V., Campbell, J. C. (2022). Higher Arm Versus Lower Arm Systolic Blood Pressure and Cardiovascular Outcomes: a Meta-Analysis of Individual Participant Data From the INTERPRESS-IPD Collaboration. Hypertension: 79.

Eliani, N. P. A. I., Yenny, L. G. S., Sukmawati, N. M.H. (2022). Daily Physical Activity is Associated with the Degree of Hypertension in the Pre-Elderly and the Elderly in the Working Area of Puskesmas I East Denpasar. e-Journal AMJ: 2(3).

Essa, R. A. & Ahmed, S. K. (2022). Prevalence of Intern-arm Blood Pressure Difference Among Young Healthy adults: Result from a Large Cross-sectional Study on 3235 Participants. Annal of Medicine and Surgery: 77.

Frese, E. M., Fick, A., Shadowsky, H. S. (2011). Blood Pressure Measurement Guidelines for Physical Therapists. Cardiopulmonary Physical Therapy Journal: 22(2).

Indonesian Ministry of Health. (2014). Indonesia Health Profile 2014. Jakarta.

Indonesian Ministry of Health. (2018). Indonesian Ministry of Health Research and Development Agency in 2018. Jakarta.

Jambi City Health Office. 2018. Jambi City Health Profile 2017. Jambi City.

Jatinugroho, Y. D. & Lontoh, S. O. (2021). The effect of changing positions on blood pressure in employees and female employees at RSU Purwogondo. Tarumanagara Medical Journal: 3(1).

Khasanah, S., Julianto, A., Yudono, D. T. (2020). Analysis of Differences in Blood Pressure Measurement Results for Hypertensive Patients in Sitting, Standing and Lying Positions. PROFESSION (Islamic Professional): Research Publication Media: 18 (1).

Kozier & Erbs. (2010). Nursing Fundamentals Textbook: Concepts, Processes, & Practices. Jakarta: EGC.

Manembu, M., Rumampuk, J., Danes, V. R. (2015). The Effect of Sitting and Standing Positions on Systolic and Diastolic Blood Pressure in North Minahasa Regency Civil Servants. e-Biomedic Journal: 3(3).

Muntner, P., Shimbo, D., Carey, R. M., Charleston, J. B., Misra, S., Myers, M. G., Ogedegbe, G., Schwartz, J. E., Townsend, R. R. Urbina, E. M., Viera, A. J., White, W. B., Wright Jr, J. T. (2019). Measurement of Blood Pressure in Humans A Scientific Statement From the American Heart Association. AHA Scientific Statement. 35-66p.

Pickering TG, Hall JE, Appel LJ, et al. (2005). Recommendations for blood pressure measurement in humans and experimental animals: Part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Hypertension: 45(1).

Potter & Perry. (2013). Fundamental Nursing Textbook. Jakarta: EGC.

Purqoti, D. N. S., & Ningsih, N. U. (2019). Identification of the Degree of Hypertension in Hypertension Patients at the Mataram City Health Center. Integrated Nursing Journal: 1(2).

Putra, R. A. A. H. S. (2021). Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of Digital Sphygmomanometer in Hypertension Screening. Medical Journal: 9(1).

Putri, FA., B. S. FE., Rahayu. (2016). Analysis of Risk Factors for Primary Hypertension in the Elderly at the Dinoyo Malang Community Health Center. SAINTIKA MEDIKA: Journal of Health Sciences and Family Medicine12 (2).

Robert, L. A. De, Canovas, G. J.J., Botella, A. J.J., Garcia, A. I.M., Alegria, L. C, Pérez-Cabrera, P.Y.D. (2019). Validity of self blood pressure measurement in the control of the hypertensive patient: factors involved. BMC Cardiovascular Disorders; 9:1–7.

Rosadi, D. & Hildawati, N. (2021). Analysis of Risk Factors for Hypertension in the Community in the Working Area of the Sungai Raya Community Health Center, Hulu Regency, Sungai Selatan. Journal of Health Epidemiology and Communicable Desease: 7(2).

Setiawan R & Sari F. (2010). Cardiovascular Physiology. Jakarta: EGC.

Smeltzer & Bare. (2013). Textbook of Medical Surgical Nursing: EGC.

Suryani, N., Noviana, Libri, O. (2020). Relationship between nutritional status, physical activity, fruit and vegetable consumption and the incidence of hypertension in the Internal Medicine Polyclinic at RSD Idaman, Banjarbaru City. Indonesian Health Journal: 10(2).