

Accuracy of Using Digital, Mercury and Aneroid Sphygmomanometer

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ABSTRACT

Blood pressure is an essential factor in the human body's circulatory system. Blood pressure is the pressure felt by the artery walls when blood is pumped by the heart throughout the body. The instrument used to measure blood pressure is a sphygmomanometer. The sphygmomanometer used to work manually, but now it works automatically using digital. The accuracy of the digital sphygmomanometer measurement depends on the battery life. The brand of digital or mercury sphygmomanometer and periodic calibration can also affect the measurement results. The purpose of this study was to see the accuracy of using a digital, mercury, and aneroid sphygmomanometer for the residents of the Rumah Bahagia Bintan Elderly Nursing Home and the Health Polytechnic of Tanjungpinang students in 2019. The design of this study was observational with a cross-sectional research design. The sample used in this study were 30 residents of Rumah Bahagia Bintan Elderly Nursing Home and 30 first-year students of Health Polytechnic of Tanjungpinang. Data were collected by measuring blood pressure with a digital, mercury, and aneroid sphygmomanometer 3 times with an examination interval of 5 minutes. The data analysis used the Mann-Whitney Test because the data were normally distributed with a significance of 5%. The study showed no difference between systolic and diastolic blood pressure using a digital, mercury, and aneroid sphygmomanometer.

Keywords: mercury sphygmomanometer; digital sphygmomanometer; aneroid sphygmomanometer; blood pressure

INTRODUCTION

Background

Blood pressure is an essential factor in the human body's circulatory system. Blood pressure is the pressure felt by the artery walls when blood is pumped by the heart throughout the body. Two critical values are used in measuring blood pressure: systolic and diastolic. The value of both systolic and diastolic blood pressure varies depending on the situation; it will increase during physical activity, emotion, stress, and sleep-deprived. ⁽¹⁾

Blood pressure is significant for the human body because high blood pressure or hypertension is a threatening disease. It can cause stroke, heart disease, aneurysms, and diabetes risk. ⁽²⁾ For this reason, regular blood pressure checks are necessary since hypertension can attack anyone at anytime.

The instrument used to measure blood pressure is a sphygmomanometer. The sphygmomanometer used to work manually, but now it works automatically using digital. ⁽³⁾ Aneroid, digital, and mercury are the most commonly used types of sphygmomanometer. The mercury sphygmomanometer is a manual sphygmomanometer with an inflatable cuff connected to a long tube filled with mercury. An aneroid sphygmomanometer, also known as a compass sphygmomanometer, is similar to a mercury sphygmomanometer but uses a compass to determine blood pressure values. ⁽⁵⁾ Digital sphygmomanometer is a device that works automatically controlled by a sensor in the process of taking blood pressure measurement data, then the results will be displayed on the screen. ⁽⁴⁾

According to the European Union Health Commission enacted regulations on April 3, 2009, the use of medical devices containing mercury is prohibited. A 2011 study at the Oxfordshire Primary Care Trust showed that the digital sphygmomanometer used has the highest accuracy value compared to the mercury sphygmomanometer. ⁽⁶⁾ However, the accuracy of the digital sphygmomanometer measurement depends on the battery life used. The brand and periodic calibration can also affect the measurement results.

Goal

The purpose of this study was to see the accuracy of using a digital, mercury, and aneroid sphygmomanometer on residents of the Rumah Bahagia Bintan Elderly Nursing Home and Health Polytechnic of Tanjungpinang students.

Hypothesis

The hypothesis of this research is to see the difference in blood pressure measurement using a mercury, digital, and aneroid sphygmomanometer.

METHODS

The design of this study was observational with a cross-sectional research design. The sample used in this study were 30 residents of Rumah Bahagia Bintan Nursing Home and 30 first-year students of Poltekkes Kemenkes Tanjungpinang. Data were collected by measuring blood pressure with a digital, mercury, and aneroid sphygmomanometer 3 times at a 5 minutes interval. The data analysis used the Mann-Whitney test because the data were normally distributed with a significance of 5%.

RESULTS

The results of this study can be seen in table 1.

Table 1. Systolic and diastolic blood pressure measurement results

Sphygmomanometer		n	Average + SD (mmHg)	Median (min-max) (mmHg)	p
Systole	Aneroid	60	128.0 + 22.078	120 (100-190)	0.778
	Mercury	60	128.17 + 19.7	121 (100-180)	
Diastole	Aneroid	60	75.5 + 8.522	70 (60-90)	0.675
	Mercury	60	74.58 + 8.796	70 (60-90)	
Systole	Aneroid	60	128.0 + 22.078	120 (100-190)	0.391
	Digital	60	132.25 + 23,758	126.5 (102-198)	
Diastole	Aneroid	60	75.5 + 8.522	70 (60-90)	0.140
	Digital	60	80.38 + 9,530	77 (55-98)	
Systole	Mercury	60	128.17 + 19.7	121 (100-180)	0.615
	Digital	60	132.25 + 23,758	126.5 (102-198)	
Diastole	Mercury	60	74.58 + 8.796	70 (60-90)	0.060
	Digital	60	80.38 + 9,530	77 (55-98)	

Based on the table 1, it can be seen that all variables did not show any difference. There was no difference between systolic and diastolic blood pressure using a mercury and digital sphygmomanometer, mercury and aneroid sphygmomanometer, as well as digital and aneroid sphygmomanometer. The null hypothesis (0) was rejected because the P-value was more than 0.05.

DISCUSSION

Based on the results of the study, it was found that there was no difference in the value of blood pressure, both systolic and diastolic, on all sphygmomanometer types. Nevertheless, the average results show a slight gap in systolic blood pressure measurement. The same as previous research on blood pressure accuracy with a digital sphygmomanometer showed a higher average value than the average standard of a mercury sphygmomanometer.^(7,8)

Differences in measurement results can be influenced by multiple things, including age, gender, arm circumference, and the type of sphygmomanometer.⁽⁹⁾ Although there are differences in measurement results between an aneroid with mercury and digital sphygmomanometer, in practice, the two types of sphygmomanometer still give significant results compared to using other types of sphygmomanometer.⁽⁶⁾ A study on primary health care patients at the Oxfordshire Primary Care Trust in 2011 stated that a digital sphygmomanometer could replace a mercury sphygmomanometer and has an equivalent level of accuracy.⁽¹⁰⁾

In contrast to a recent study conducted by Shahbabu, Dasgupta, Sarkar & Sahoo, 218 study subjects showed the mean difference between the mercury reading and the test device was much less for aneroid than that of the digital device for both systolic and diastolic blood pressure. More than 89% of aneroid readings and less than 44% of the readings by digital device had an absolute difference of 5mm Hg, compared with the mercury readings for both systolic and diastolic blood pressure. The sensitivity and specificity of the aneroid device were higher (86.7%

and 98.7%) than the digital device (80% and 67.7%). The conclusion is that an aneroid is more accurate than a digital and mercury sphygmomanometer.⁽¹¹⁾

CONCLUSION

Statistically, there is no significant difference in blood pressure measurements (systolic and diastolic) on the three sphygmomanometers type: mercury, digital, and aneroid sphygmomanometers.

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