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Original Research Article

A COMPARATIVE STUDY OF AUTOMATED V/S MANUAL MEASUREMENT OF BLOOD PRESSURE IN A TERTIARY CARE HOSPITAL

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Abstract

Background: Accurate blood pressure measurement is crucial for the diagnosis and management of a variety of clinical disorders. Since its invention more than a century ago, the mercury sphygmomanometer has been the gold standard for measuring blood pressure. **Objective:** To assess any differences in the values between the manual mercury sphygmomanometer and the digital version. **Materials and Methods:** A cross sectional study was undertaken after taking a convenient sample size of 100 apparently healthy first year MBBS students (males n = 68, and females n = 32). After taking written informed consent and approval from IEC from tertiary care institute and hospital, students were enrolled in the study. Questionnaires were provided to obtain demographic data from students. Inclusion criteria: Those who gave consent were included in the study. The study excluded students who had a history of hypertension, heart disease, endocrine abnormalities, obesity, or renal disease. Between the hours of 2 and 5 in the afternoon, blood pressure readings were recorded. Prior to taking their blood pressure, subjects were allowed to rest for five minutes. **Results:** The difference between mean SBP and DBP in males recorded using the two devices were not statistically significant. The difference between mean SBP and DBP in females recorded using the two devices were not statistically significant. **Conclusion:** The digital sphygmomanometer reduces white coat hypertension and removes observer bias. The mercury sphygmomanometer is still the gold standard for measuring blood pressure, but after performing the necessary calibration and validation, those who lack the necessary skills to measure blood pressure using the standard method can use the digital device because it is simpler and more convenient.

INTRODUCTION

In the present era of rising non-communicable diseases, hypertension has long been known as the silent killer.[1] Cardiovascular illnesses are at risk due to hypertension, which is also linked to multisystemic problems and early mortality. The management of hypertension and the prevention of consequences depend on early identification. Blood pressure measurements must be precise in order to diagnose and monitor people with high blood pressure.[2] The mercury sphygmomanometer has been the de facto non-invasive gold standard for monitoring blood pressure for more than a century. But as people's knowledge of mercury's toxicity and potential environmental effects has grown, other sphygmomanometers have begun to take the place of mercury sphygmomanometers.[3] With changes in the person's posture, both the SBP and DBP frequently alter. Automated devices help reduce white coat hypertension in people and remove observer bias because they are non-invasive, simple to use and monitor, automatically provide results, portable, and easy to carry. They are also very useful in remote areas when medical facilities are not readily available.[4]

Sphygmomanometers (instruments) of different business makes could yield various findings. The outcomes of studies can also vary depending on the time of year and season they are conducted. The number of studies examining the precision and dependability of automated blood pressure monitors is extremely small.[4] In order to compare the readings obtained by the manual mercury sphygmomanometer with the digital sphygmomanometer and to ascertain variances in the readings (if any), the current study was conducted.

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MATERIALS AND METHODS

A cross sectional study was undertaken after taking a convenient sample size of 100 apparently healthy second year MBBS students (males n = 68, and females n = 32) since they have clinical postings from this year. After taking written informed consent and approval from IEC from tertiary care institute and hospital, students were enrolled in the study. Questionnaires were provided to obtain demographic data from students. Inclusion criteria: Those who gave consent were included in the study. The study excluded students who had a history of hypertension, heart disease, endocrine abnormalities, obesity, or renal disease. Between the hours of 2 and 5 in the afternoon, blood pressure readings were recorded. Prior to taking their blood pressure, subjects were allowed to rest for five minutes. The participant was asked to relax in a chair with the arm resting on a table that was kept at heart level. In the sitting, standing, and recumbent positions, the blood pressure was measured in the dominant arm using a mercury sphygmomanometer (PULSE WAVE 300 NISCO) and a digital sphygmomanometer (OMRON HEM - 7130). A 2-minute gap separated each of the three readings that were taken in each location. To check for any differences, the mean of the blood pressure readings (systolic and diastolic) were compared between the mercury and digital sphygmomanometers.

Statistical Analysis

Data so obtained were subjected to statistical analysis. Data analysis was done by SPSS software ® version 24.0. Descriptive statistical analysis, which included frequency and percentages, was used to characterize the data. Chi-square test was used for association between factors and $p < 0.05$ was considered statistically significant.

RESULTS

Table 1: SBP and DBP in Sitting, Standing, and in Recumbent Postures Using Mercury and Digital Sphygmomanometers in Males

	Systolic Blood Pressure						Diastolic Blood Pressure					
Posture	**Sitting**		**Standing**		**Recumbent**		**Sitting**		**Standing**		**Recumbent**	
Sphygmomanometer Type	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital
Mean Blood Pressure (mmHg)	114.71	115.21	114.08	117.42	118.53	119.31	69.27	68.05	72.15	74.76	72.93	67.70
Standard Deviation	11.16	10.29	10.4	11.43	10.61	12.12	8.23	10.29	7.65	9.17	6.50	7.11
Df			56						56			
P value	4.15		0.31		0.35		2.14		0.56		3.27	
	Not significant		Not significant		Not significant		Not significant		Not significant		Not significant	

As per table 1 The mean SBP recorded in males using the mercury sphygmomanometer was found to be 114.71 ± 11.16 mmHg, 115.21 ± 10.29 and 119.31 ± 10.61 mmHg, and the mean DBP was found to be 69.27 ± 8.23 mmHg, 72.15 ± 7.65 mmHg and 72.93 ± 6.50 mmHg in sitting, standing and recumbent postures respectively. The mean SBP recorded using digital sphygmomanometer was found to be 115.21 ± 10.29 mmHg, 117.42 ± 11.43 mmHg and 119.31 ± 12.12 mmHg and the mean DBP recorded was found to be to be 69.27±8.23 mmHg, 72.15 ± 7.65 mmHg and 72.93±6.50 mmHg in sitting, standing and recumbent postures respectively. The difference between mean SBP and DBP in males recorded using the two devices was not statistically significant.

Table 2: SBP and DBP in Sitting, Standing, and in Recumbent Postures Using Mercury and Digital Sphygmomanometers in Females

Systolic Blood Pressure							**Diastolic Blood Pressure**					
Posture	**Sitting**		**Standing**		**Recumbent**		**Sitting**		**Standing**		**Recumbent**	
Sphygmomanometer Type	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital	Mercury	Digital
Mean Blood Pressure (mmHg)	102.03	97.09	103.31	101.54	108.6	105.57	62.85	62.15	66.89	69.21	67.33	66.44
Standard Deviation ±	9.49	10.48	9.19	13.15	9.55	10.78	8.76	8.18	6.54	9.61	8.16	9.44
Df			90						90			
P Value	5.12		7.27		3.19		3.19		0.27		0.11	
	Not significant		Not significant		Not significant		Not significant		Not significant		Not significant	

As per table 2 The mean SBP recorded in Females using the mercury sphygmomanometer was 102.03 ± 9.49 mmHg, 103.31 ± 9.19 mmHg and 108.60±9.55 mmHg, and the mean DBP recorded was found to be 62.85 ± 8.76 mmHg, 66.89 ± 6.54 mmHg and 67.33 ± 8.16 mmHg. The mean SBP recorded using digital sphygmomanometer was found to be 97.09 ± 10.48 mmHg, 101.54 ± 13.15 mmHg and 105.57 ± 10.78 mmHg and the mean DBP recorded with the digital sphygmomanometer was found to be 62.15 ± 8.18 mmHg, 69.21 ±

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9.61 mmHg and 66.44 ± 9.44 mmHg in sitting, standing, and recumbent posture respectively. The difference between mean SBP and DBP in females recorded using the two devices was not statistically significant.

DISCUSSION

In our investigation, there was no statistically significant difference between the blood pressure readings obtained using a mercury sphygmomanometer and a digital sphygmomanometer. As is common knowledge, the indirect technique is used to measure blood pressure, and its basic premise is the balancing of air pressure in a bag against the pressure of blood in an artery. Using a mercury sphygmomanometer, the air pressure is estimated.[5] We used a digital sphygmomanometer made by Omron, the Hem 7130 model, to record blood pressure. According to studies by Jeyanthi N et al.[6] the Oscillometric approach is used in digital blood pressure recording. Electric pressure sensors are used to calculate blood pressure. There will be vibration against the arterial wall and the occurrence of cyclic expansion and contraction in the artery when the cuff is inflated with air, which causes the arteries to become compressed and narrowed and prevents blood from passing through them. Conversely, when the pressure in the cuff is slowly released, blood can pass through the artery. Then, using a general method, the systolic and diastolic blood pressure is determined at the time the peak cyclic value is reached.

Our study's results were different from those of studies by Srinivasan et al. and Bhatt et al., which concluded that BP measurements obtained using digital manometers significantly differed from those obtained using mercury manometers and displayed higher levels of inaccuracy, requiring greater caution when used in clinical settings.[7,8] Differences in study settings and the type of instruments employed may be to blame for variations in our study's findings.

Our study's findings supported a study by Wadhwani et al. that found oscillometric devices offer somewhat higher SBP readings than mercury sphygmomanometers do, although automated blood pressure readings and mercury sphygmomanometer readings are comparable.[9] In our investigation, no such variation in readings was noticed. Similar studies conducted in the Canadian population came to the same conclusion: automated devices that have been calibrated and validated can take the place of traditional manual mercury sphygmomanometers.[10]

Our study has few limitations. Firstly, our study was limited to a sample size of 100 apparently healthy young adults, hence results of our study cannot be generalized to the entire population and so further studies with a larger sample size with different age groups should be undertaken. Secondly, the study used sphygmomanometers (instruments) from two different company makes: The Omron digital sphygmomanometer and the pulse wave mercury sphygmomanometer. Because different sphygmomanometers (instruments) from different company makes could produce different results, further research is required to confirm the accuracy of these instruments.

CONCLUSION

The blood pressure measurements obtained with the manual mercury and automated digital sphygmomanometers show no appreciable difference. They can also be used interchangeably in routine clinical practice because the systolic and diastolic blood pressure readings obtained using manual mercury and digital devices were equivalent. Automated gadgets are less invasive, simpler to operate, and secure to monitor. The digital sphygmomanometer reduces white coat hypertension and removes observer bias. The mercury sphygmomanometer is still the gold standard for measuring blood pressure, but after performing the necessary calibration and validation, those who lack the necessary skills to measure blood pressure using the standard method can use the digital device because it is simpler and more convenient.

Conflict of Interest None.

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