Original Article

Accuracy of BP from different Devices

Accuracy of Automated Blood Pressure Assessment Device Confirmed by Mercury Sphygmomanometer

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ABSTRACT

Objective: To determine the accuracy of automated blood pressure assessment device confirmed by mercury sphygmomanometer.

Study Design: Cross sectional study

Place and Duration of study: This study was conducted at Pediatric department Qazi Hussain Ahmad Medical Complex Nowshera from July 2019 to December 2019.

Materials and Methods: In this study a total of 212 patients were observed. All the children were put on an examination bed over 45 degree angle and a rest period was allotted of approximately 5 minutes. After rest period, the BP both systolic and diastolic was measured using Omron HEM-907XL automated BP measuring device. From each patient, three readings were obtained and an average of these three readings was recorded for further analysis. After BP measured with automated device, another rest period of 5 minutes was give to each participant of the study before measuring the BP using standard mercury sphygmomanometer.

Results: The mean age of patients was 10 ± 7.53 years. There were 56% males and 44% female children. Mean BMI was 25Kg/m^2 with SD ± 4.463. More over automated BP was accurate in 72% patients and was not accurate in 28%.

Conclusion: Our study concludes that the accuracy of automated BP measuring device was 72% confirmed by mercury sphygmomanometer.

Key Words: accuracy, automated blood pressure, mercury sphygmomanometer

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INTRODUCTION

Raised BP or hypertension is one of the most leading cause of mortality all over the world. It may cause about 12.8% of all the deaths occurring around the world, including 51% deaths related to stroke and 45% deaths related to the of coronary artery disease. Increasing age is a major non-modifiable factor that leads to hypertension; as 90% individuals can develop certainly develop hypertension in their lives after the age of fifty five years.[1-3]

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The increase in the incidence of hypertension in young adults is alarming. The Bogalusa Heart Study and Patho-biological Determinates of Atherosclerosis in Youth study determined that among autopsies, the increased atherosclerosis was the reason for elevated blood pressure in young individuals. Consequently, the accurate measurement of blood pressure and proper treatment of this elevated blood pressure in pediatrics age group and in adolescence is necessary to prevent the development of cardiovascular diseases. It has been suggested that the ambulatory monitoring of blood pressure can be a better prognostic than clinical assessment for the prediction of cardiovascular complications and deaths in adult individuals. Thus, the use of ambulatory blood pressure monitoring is increasing for evaluation of hypertension and the risk of end-organ impairment in adults.[4-8]

But there are some problems with ambulatory blood pressure monitoring that must be taken into consideration. Several automated ambulatory blood pressure devices depend on oscillometric method, which is observed to have less accuracy than examining the diastolic blood pressure (DBP) than systolic blood pressure (SBP). However, this may be false for many devices. Alternatively, all the indirect methods for assessment of blood pressure are less accurate for

determination of both SBP &DBP as compared to direct intra-arterial measurements.[9-11]

New tools for the assessment of blood pressure including the automatic oscillometric blood pressure devices are replacing the gold standard tool i.e. mercury sphygmomanometer in numerous clinical set-ups. But, there are the circumstances where the replacement of oscillometric for auscultator devices could have mostly severe ramifications for patients, like when patient have either hypertension or hypotension. Though, further studies are warranted regarding the use of aneroid sphygmomanometer as the improved replacement of mercury device. In a study, the accuracy of oscillometricblood pressure device was 81%that measure the blood pressure accurately, while it as reported as 70.28% in the other study.[12-14]

The present study was designed to determine the accuracy of automated BP monitoring devices compared to the mercury sphygmomanometer. As mentioned above, there is a threat of rise in the cardiovascular diseases among pediatric population and there are a No of devices which run on automated ocillometric principles for measuring the BP. This study would be very useful in determining the accuracy of automated BP measuring devices which are commonly used for BP monitoring for children at homes and clinics. This study will give us local statistics about the accuracy of these devices and on the basis of results of this study, we will formulate future research recommendations which will help us in efficient monitoring of BP of children at homes and at clinics.

MATERIALS AND METHODS

The cross sectional study was done at pediatric department Qazi Hussain Ahmad medical complex Nowshera. Sample size was 212 keeping 70.28%[14] proportion of accuracy (sensitivity) of automated BP measuring device, 95% confidence level and 6% margin of error using WHO sample size formula. Sampling technique used was consecutive (non probability) sampling. Children of age 3-18 years of both gender were included while children with diagnosed hypertension, history of any type of cardiovascular abnormality, congenital heart problems were excluded. All the children who fulfilled the selection criteria were enrolled from the OPD. Consent form was taken from parents or guardians attending the child. Then detailed history and clinical examination was done in all children. All the children were put on an examination bed over 45^{O} angle and a rest period was allotted of approximately 5 minutes. After rest period, the BP both systolic and diastolic was measured using Omron HEM-907XL automated BP measuring device. From each patient, three readings were obtained and an average of these three readings was recorded for further analysis. After BP measured with automated device, another rest period of 5 minutes was given to each participant of the study before measuring the BP using standard mercury sphygmomanometer. Accuracy was determined in terms of number of patients having automated device measured systolic BP+ 5mmHg and Diastolic BP+ 3mmHg as confirmed by mercury sphygmomanometer. Data was entered and analyzed via SPSS v. 20. Mean + SD was calculated for numerical variables like age, Systolic BP, Diastolic BP, height, weight & BMI. Frequency & percentage were calculated for categorical variables like gender, true positive, false negative& sensitivity.

RESULTS

The mean age of children included in the study was 10 ± 7.53 years. There were 89 (42%) children of age 3-10 years, while 123 (58%) children were of age range 11-18 years. Out of 212 children, there were 119(56%) males and 93(44%) females. The mean systolic BP was 110 ± 12.56, mean diastolic BP was 80 ± 12.56, mean height was 1.3 ± 1.102 meters and mean weight was 30 ± 6.271 Kg. BMI distribution among 212 patients was analyzed as 187(88%) patients had BMI ≤25 Kg/m^2 and 25(12%) patients had BMI >25% Kg/m^2. Mean BMI was 25 ± 4.46 Kg/m^2. (table no 1)

Accuracy of the automated BP assessment device among 212 candidates was analyzed as the measurement of automated BP device was accurate in 152 (73.1%) patients. (Table no 2)

Table No. 1. Demographics of patients

N	212
Age	10 ± 7.53
3-10 Years	89 (42%)
11-18 years	123 (58%)
Male	119 (56%)
Female	93 (44%)
Systolic BP	110 ± 12.56
Diastolic BP	80 ± 8.81
Height	1.3 ± 1.10
Weight	30 ± 6.27
BMI	25 ± 4.46
≤25 Kg/m^2	187 (88%)
>25 Kg/m^2	25 (12%)

Table No. 2: Accuracy (Sensitivity) of automated BP measuring device confirmed by mercury sphygmomanometer.

Hypertension on		Mercury Sphygmomanometer		Total
		Positive	Negative	
Automated device	Positive	152	1	153
	Negative	56	3	59
Total		208	4	212

Sensitivity = 73.1%

Kappa = 0.062

DISCUSSION

Hypertension or elevated BP is normally observed in aged candidate, and this rise usually occur after age of 40-50 years, and about 90% individuals develop hypertension after age of 55 years. But elevated BP has also been observed pediatric population also.[1-3] Our study concludes that mean age of candidates was 10 ± 7.53 years. There were 56% males and 44% females. Mean BMI was 25Kg/m^2 with SD ± 4.463. Moreover, automated BP was accurate in 72% cases.

Similar findings were reported by another research done by Ostchega et al. They presented the accuracy of oscillometric BP instruments for accurately measuring the BP was recorded in 81% of participants and it was reported as 70.28%.[14]

Similar finding were noticed in previous studies. A study by Natalie et al., found the validity of device in 61% studies which used as standard protocol. Only 34% studies where the device was effectively confirmed were executed without violation in protocols.[15]

In another study Mansoor et al., had conducted a study on 200 individuals. The mean difference in SBP was 8.54 ± 9.38 mmHg while the mean difference in DBP was 4.21 ± 7.88 mmHg. Eighty nine individuals have already known hypertension; and the difference of mean SBP was 9.43 ± 9.89 mmHg (p-value = 0.000) and difference in mean DBP was 4.26 ± 7.35 (p-value = 0.000).[16]

In another study Lim et al.,conducted a study on 454 patients with the mean age of 50.7± 15.4 years. The mean SBPs was 119.8 ± 139 mmHg on the MM while 119.5 ± 13.6 mmHg on AD in males,whereas among females, the mean SBPs was 115.0±16.8 mmHg on MM and 111.6±15.7 mmHg on AD. The mean DBP among males was 77.7±10.4 mmHg on MM while 74.7±10.4 mmHg on AD, whereas among females, the mean BDP was 73.2±9.3 mmHg on MM and 69.9±10.3 mmHg on AD. The kappa statistics was0.6538 (0.5436–0.7641) for detection of hypertension. The diagnostic sensitivity for hypertension was 59.0%.[17]

CONCLUSION

Our study concludes that the diagnostic accuracy of the automated BPassessment device was 72% confirmed by mercury sphygmomanometer.

Author's Contribution:

Concept & Design of Study:	Muhammad Shafiq
Drafting:	Irfan Ullah, Irfan Khan
Data Analysis:	Khalid Khan, Khalil Ahmad, Waseem Ur Rahman
Revisiting Critically:	Muhammad Shafiq, Irfan Ullah
Final Approval of version:	Muhammad Shafiq

Conflict of Interest: The study has no conflict of interest to declare by any author.

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