

COMPARISON OF AUTOMATED AND MERCURY BLOOD PRESSURE MEASUREMENT AMONG PREGNANT WOMEN IN RURAL HEALTHCARE SETTINGS

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ABSTRACT

BACKGROUND

Various kinds of error can arise during the process of blood pressure measurement and it is more with Mercury Sphygmomanometers (MM). Its comparability with the use of Automated Blood Pressure Measurement Devices (AD) is unequivocal. So, the present study was taken up to compare the blood pressure measurement using automated and mercury sphygmomanometer among the pregnant women in primary healthcare settings of Hassan district.

The aim of the study is to compare clinical blood pressure measurement using automated and mercury sphygmomanometers among pregnant women in primary healthcare settings.

MATERIALS AND METHODS

A cross-sectional study was conducted in two primary health centres of Hassan district between February 2016 to August 2016. Blood pressure was recorded in 357 pregnant women using both mercury and automated sphygmomanometers (Omron HEM-8721). Two readings were taken in sitting position in a nondominant arm with one minute gap using both devices separately. The mean of two recordings recorded with both the devices were considered as the blood pressure of that mother. There was a 2-minute gap between automatic and manual BP readings. All measurements were obtained under similar conditions except for the two different BP recording techniques used. The ethical clearance has been taken from Institutional Ethical Committee. Data was analysed by using SPSS 18.

RESULTS

The mean age of the participants was 22.56±3.29. The mean of systolic blood pressure using the MM and AD were 106.35±10.07 and 106.16±11.30 respectively and mean of diastolic blood pressure were 66.65±9.39 and 66.53±9.42, respectively. Systolic BP was >130 mmHg for 17 manual and 14 automated measurements. Diastolic BP was ≥90 mmHg for 13 manual and 11 automated BP readings. Through scatter plot-it was found highly correlated between systolic and diastolic measurement using two different types of instruments. Also, for reliability between variables, Cronbach's alpha value found was 0.917 and 95%, CI; 0.89-0.93, which is highly significant.

CONCLUSION

Digital blood pressure equipment is equally efficient and comparable to conventional ones in all aspects for wider usage in different setups.

KEYWORDS

Automated Devices, Pregnant Women, Blood Pressure Measurement, Systolic Blood Pressure, Sphygmomanometers.

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BACKGROUND

Blood pressure is recorded during each antenatal visit. Hypertensive disorders of pregnancy are one of the leading causes of maternal morbidity and mortality accounting for 10-15% of maternal deaths, especially in developing

world.¹ So, accurate measurement of blood pressure is critical to make diagnosis among pregnant women. Various kinds of error could arise in this process originating from uncalibrated devices, improper technique or examiner error.² Various studies recognised that automated devices systematically underestimate both systolic and diastolic blood pressure in adults and in pregnant women and often by clinically significant amounts.³ Although, mercury sphygmomanometer remains the gold standard for measurement of blood pressure in the clinical practices.⁴ The use of mercury devices may lead to observer bias as it depends on the accurate detection of Korotkoff sounds with a stethoscope. Automated blood pressure measuring devices are increasingly used for environmental reasons⁵ (mercury toxicity), convenience of use and their lower

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susceptibility to several observer-related biases (e.g. systematic error, terminal digit preference) and free of observer bias.⁶

Even if BP is measured by using multiple measurements, there is no general agreement regarding the use of ADs for single measurements⁷⁻⁸ and nowadays use of automated blood pressure measurement devices (AD) to detect blood pressure changes are becoming increasingly widespread in healthcare settings. Their comparability with manual Mercury Sphygmomanometer (MM) readings is unequivocal. Moreover, a recent study on comparison between an AD and MM suggests that the AD devices are easy to use and underestimate the prevalence of hypertension⁹ and only few studies have demonstrated this variation among pregnant women. So, it is important to assess use of these devices and comparison of measurements of both mercury and automated devices in an obstetric population.

So, the present study was taken up to compare blood pressure measurement among pregnant women using automated and mercury sphygmomanometer in primary healthcare settings of Hassan district.

Objectives

To compare clinical blood pressure measurement using automated and mercury sphygmomanometer among pregnant women in primary healthcare settings.

MATERIALS AND METHODS

A cross-sectional study was conducted between February 2016 to August 2016. All pregnant women irrespective of period of gestation attending two primary health centres for a period of six months were included in the study. A total of 357 pregnant women who attended the primary health centers (Banavara and Jagal of Arsikere Taluk) were included for the BP measurements. Around 135 PHCs are situated in entire Hassan district. Among that, Banavara PHC having highest population (40,000) followed by Javagal PHC (32,000) were selected as our study population. With the available data for last six months from this PHC, more than 350 new ANC registered cases were documented. Based on that, we enrolled 357 pregnant mothers from respective PHC's in a stipulated time. BP was recorded among all pregnant women using mercury sphygmomanometer and digital sphygmomanometer.

BP measurements- BP was recorded by using both mercury and automated sphygmomanometer (Omron HEM-8721). Korotkoff phase I and V sounds were taken as Systolic BP (SBP) and Diastolic BP (DBP), respectively. They were allowed to rest for five minutes in a quiet room before the first reading was taken. Two readings were taken in sitting position in a nondominant arm with one minute gap using both devices separately. The mean of two recordings recorded with both the devices were considered as the blood pressure of that mother. There was a 2-minute gap between automatic and manual BP readings. All measurements were obtained under similar

conditions except for the two different BP recording techniques used.

Sociodemographic details like age, education, occupation, religion, parity, obstetric history, past history about hypertensive and diabetic status, family history of hypertension were taken from all the participants and detailed clinical examination was done. Weight was measured by standard weighing machine, which is calibrated periodically.

Height was measured by asking women to stand against a wall with her bare feet touching each other, the heel, calf, buttock, upper back and occiput touching the wall and the pregnant women looking straight ahead. A firm scale is pressed to the head to mark the point indicating height. Value is taken near to 0.1cm by using tape. The Body Mass Index (BMI) was calculated from dividing weight (in kg) by height in meters (squared) expressed in kg/m².

A written informed consent was taken from all pregnant women after explaining the purpose of the study. The ethical clearance has been taken from Institutional Ethical Committee.

Data Analysis- Mean and standard deviation of manual and automated systolic and diastolic BP values were taken. A correlation analysis was performed to examine the relationship between the automated and manual BP readings with the automated systolic and diastolic BPs. All data was analysed using SPSS version 18.

RESULTS

Baseline characteristics of participants are presented in Table 1. A total of 357 pregnant women were subjected to BP measurements using both devices. 43% of pregnant mothers were gravida 2, 39.95% of pregnant mothers were primi and only 16.7% of pregnant mothers are gravida 3 and above. Among all pregnant mothers, 5.04% were illiterate, 2.52% were educated up to primary school, 14.56% up to middle school, 39.78% up to high school, 26.61% up to intermediate, 10.64% were graduated and 1.12% were postgraduates. 95.8% were found to be unemployed followed by 3.36% were semi-professional, 0.56% were unskilled workers and 0.28% were semiskilled workers.

Majority of the study participants belongs to Hindu religion (81%) and 18.65% were Muslims. Half of them belong to BMI category 20-24, 22% of pregnant women belongs to pre-obese category and 8% belongs to obese category.

Characteristics	Mean (SD)
Age (yrs.)	22.56±3.29
Weight (kg)	55.57±11.12
Height (cms)	153.99±6.53
BMI	23.42±4.46
Gestational weeks	24.24±7.99
Primi(%)	39.95
SBP(MM)	106.35±10.07
DBP(MM)	66.65±9.39
SBP(AD)	106.16±11.30
DBP (AD)	66.72±9.47

Table 1. Baseline Characteristics of Study Population

The mean age of the participants was 22.56±3.29. The mean of systolic blood pressure using the MM and AD were 106.35±10.07 and 106.16±11.30 respectively and mean of diastolic blood pressure were 66.65±9.39 and 66.72±9.42, respectively. Systolic BP was >130 mmHg for 17 manual and 14 automated measurements. Diastolic BP was ≥90 mmHg for 13 manual and 11 automated BP readings.

The prevalence of hypertension among pregnant women was found to be 6.16% and 5.81% using mercury and automated sphygmomanometer, respectively.

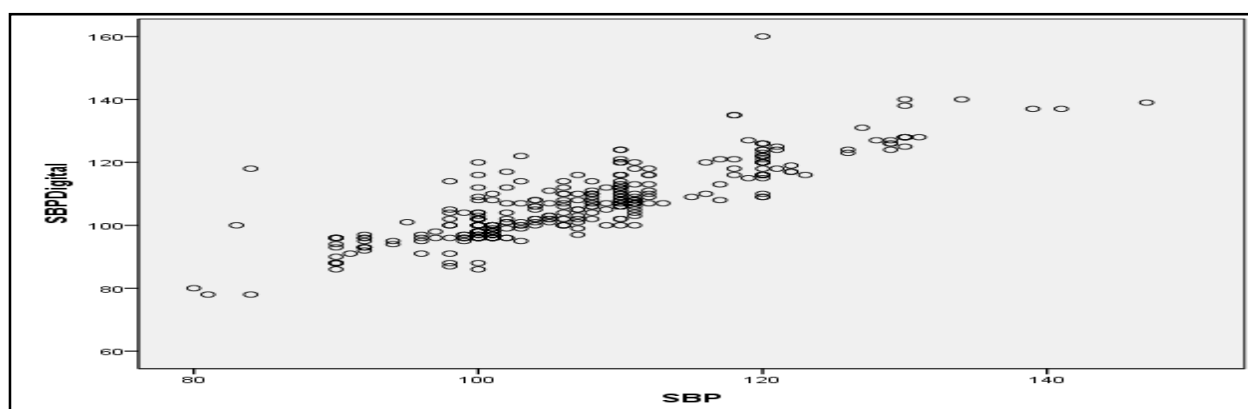


Figure 1. Correlation between Systolic BP Measurements using Two Instruments

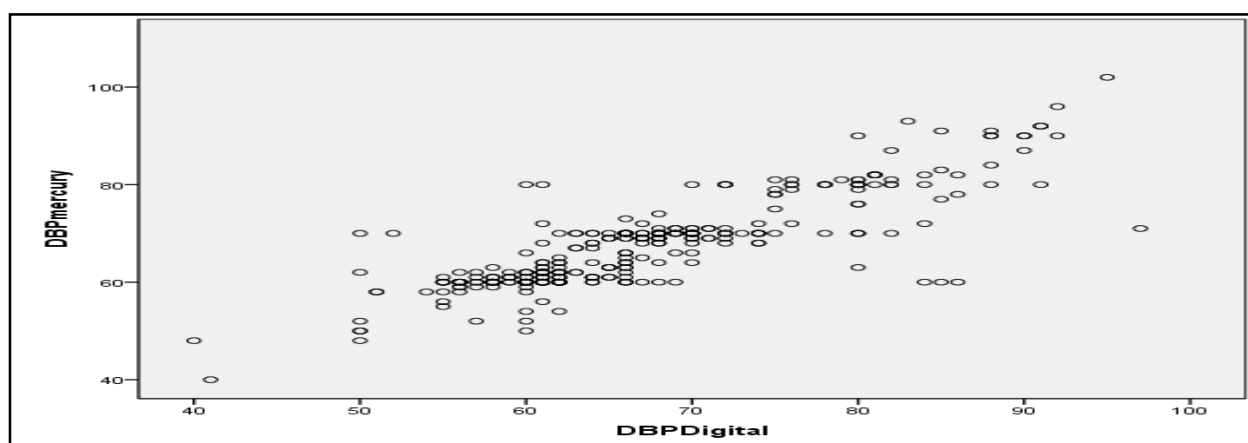


Figure 2. Correlation between Diastolic BP Measurements using Two Instruments

Through scatter plot-it was found that high correlation was seen between systolic and diastolic measurements using two different types of instruments. Also, for reliability between variables, Cronbach's alpha value found was 0.917 and 95%, CI; 0.89-0.93, which is highly significant.

DISCUSSION

The automated devices are designed to minimise the impact of observer-subject interaction on measurement of BP in the clinical settings.¹⁰ This approach removes several aspects of bias associated with conventional BP measurement using mercury sphygmomanometer.¹¹ The role digital devices is to eliminate observer bias and imprecision due to factors such as digital preference, too rapid deflation of the cuff or reading up or down to influence the patient's BP status.

Compared with mercury sphygmomanometers, automated devices were generally thought to underestimate BP in crossover studies,¹² although this belief is still controversial.¹³

In the present study, an investigator alone performs the automated readings and manual BP measurements under standard conditions. The mean values were quite similar. In a population survey conducted by Mayer MG et al, mean (±S.D.) BP taken with the automated device was 115 ± 16/71 ± 10 mmHg compared to 118 ± 16/74 ± 10 mmHg for the manual BP readings. In our study, mean ± S.D. of measurements taken using a mercury sphygmomanometer (106.35 ± 10/66.65 ± 9) was almost similar to the measurements taken by using automated sphygmomanometer Omron-HEM 8271 (106.16 ± 11/66.72 ± 9).

In a formal validation study conducted by Wright et al,¹⁴ mean blood pressure values for systolic and diastolic BP differed from reference readings taken with a standard mercury device by only $-0.2 \pm 4.3/-1.4 \pm 4.2$ mmHg, respectively.

Another study conducted by Ostchega Y et al⁹ shows an overall lower readings using the Omron device for both SBP (1.62 ± 6.14 mmHg) and DBP (1.64 ± 6.63 mmHg) averages and a greater underestimation for SBP (2.37 ± 6.34 mmHg) than DBP (1.50 ± 5.94) in individuals and The Omron and mercury measurements were highly correlated ($r=0.94$ for systolic BP and $r=0.83$ for diastolic BP). Another validation study conducted by Omboni S et al¹⁵ suggested an underestimation of DBP by an average of 5 mmHg and also recommended use of Omron devices for clinical measurement of blood pressure among elderly population.

In our study, the prevalence of hypertension among pregnant women was found to be 6.16% and 5.81% using mercury and automated sphygmomanometers. In a study conducted by Myers MG et al, the 8% labeled as hypertensive according to a cutpoint of $<140/90$ mmHg for normal manual BP and 9% with a normal automated BP set at $<135/85$ mmHg.

The conventional manual BP readings taken using mercury sphygmomanometer can be replaced by a validated automated sphygmomanometer. In automated recorder, observer-subject variation will be less and low BP readings in participants with high normal or mild hypertension helps to reflect the true prevalence status of hypertension in the pregnant women.

One limitation of our study is that measurements apply to only one AD monitor and cannot be generalised to other devices. Additionally, our study results cannot be directly approached to other populations even with same measurement device, because the factors related to errors might be different between populations.

CONCLUSION

Based on the present study observation, one can conclude that digital blood pressure equipment is equally efficient and comparable to conventional ones in all aspects. However a larger study with different patient sub groups may be required to recommend it for wider usage in different setups.

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