



# COMPARATIVE STUDY OF BLOOD PRESSURE MEASUREMENT BY ANEROID AND DIGITAL MANUAL SPHYGMOMANOMETER

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## ABSTRACT

**Introduction:** After discontinuation of mercury sphygmomanometer, aneroid BP instrument and digital manual BP instrument are commonly used methods in clinical practice. This study was opted to compare the results of blood pressure measurement by aneroid and digital manual sphygmomanometer and determine the agreement between the two apparatus.

**Material and Method:** After written consent, nursing students of Shardaben General Hospital were enrolled in the study. Their blood pressure was measured by both the methods at 5 minute interval in left upper limb. Their reading was documented and analyzed by appropriate statistical test.

**Results:** Mean Systolic Blood pressure by digital and aneroid sphygmomanometer was 108.92±15.14 and 109.66± 16.81 mm of Hg respectively. Mean Diastolic Blood pressure by digital and aneroid sphygmomanometer was 76.20±12.25 and 78.02±14.35 mm of Hg. By Bland -Altman test, the bias for mean systolic BP was 0.74(-9.0-10.5) and 1.8(-8.28\_11.93) for mean diastolic BP by both the apparatus which is clinically non-significant.

**Conclusion:** Blood pressure readings by digital manual and aneroid sphygmomanometer are comparable, so both the apparatus can be used interchangeably in clinical practice.

**Key words:** aneroid sphygmomanometer, digital manual sphygmomanometer, blood pressure.

## INTRODUCTION

Accurate blood pressure measurement is key element for physical examination in adults as well as in children. Blood pressure is important in the diagnosis and monitoring of a wide range of clinical conditions. There are different invasive and non-invasive methods to measure blood pressure.<sup>1,2</sup>

Mercury sphygmomanometers had been used by healthcare professionals over the last 100 years in both hospital and ambulatory settings as a gold standard. However, environmental concerns regarding mercury meant that there is no long-term future for these devices.<sup>3</sup> These concerns have led to the imposition of ban on mercury in most of the

countries and it can no longer be used in medical equipments.

This has led to the use of other alternate apparatus mainly oscillometric (automatic electronic) which translate arterial pressure in oscillometric wave and with system built algorithm display readings. Another popular handy device is aneroid which translates pressure to mechanical force and measurements are taken. Two studies from US which compared aneroid and mercury sphygmomanometer found minimal difference between readings<sup>4,5</sup>. Automated oscillometric device is found very helpful for home measurements but needs close supervision.<sup>6</sup> The digital LED sphygmomanometer

works on oscillometric principal but readings are taken by auscultating Koroskoff sound manually<sup>7</sup>. Limited or no data exist on the comparison of aneroid and digital manual sphygmomanometer.

This study was opted to compare aneroid and digital manual sphygmomanometer and to determine agreement between the two devices.

The aim of the study was to compare the results of blood pressure measurement by aneroid and LED manual sphygmomanometer and determine agreement between two apparatus.

**MATERIAL AND METHOD**

This Cross sectional clinical study was done in September 2015. After written informed consent and permission from institute authority, nursing students of SCL General hospital were enrolled in the study. Their demographic profile in form of age, name, gender, weight by digital weighing scale with accuracy of 50 grams, height in cm by stadiometer were measured and documented.

Significant past history in form of hypertension, cardiac problem, endocrine disorder, major illness, surgery and family history of hypertension, diabetes, cardiac disease were elicited and documented. Their pulse was taken in right radial artery for one minute and documented.

After rest of 15 minutes in a classroom, their BP was measured by a qualified physician by both instruments at 5 minutes interval under ideal recommended conditions\*.BP was measured in right arm and first and fifth Korotkoff sound were recorded as systolic and diastolic BP readings by both devices. (Aneroid- Rossmax Mercury free aneroid BP instrument .Digital- Diamond Mercury free LED BP instrument). Readings were documented as systolic and diastolic BP in mm of Hg by both instruments.

Data were analyzed by statistical software SPSS( version 20.0 IBM) and calculated for mean + 2SD.Systolic and diastolic BP measured by both apparatus were compared and amount of bias was calculated. Data was plotted on Bland –Altman graph for better visual comparison.

**RESULTS:**

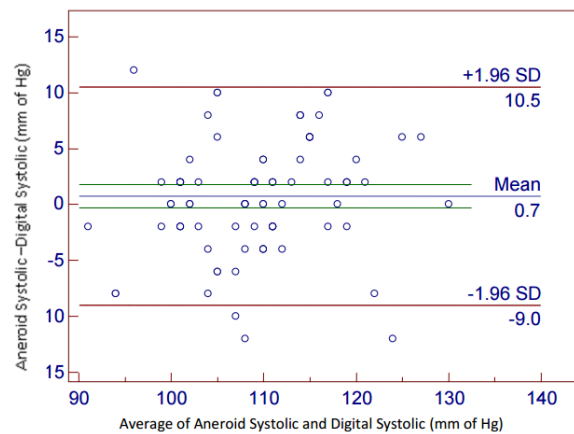
Total 89 students with age range of 18.1 to 23.3 years had participated, amongst them 83 were female and 6 were male. Mean weight of girls was 48+17.61 and of boys was 53 +17.61kg. Mean height of girls was 154 +13.99 and of boys was 171 +13.99cm. Mean BMI of girls was 19.10 +3.61 and of boys was 19.65 +3.61.

Mean pulse rate of girls was 92 +28.71 and of boys was 86 +28.71. Amongst them 3 girls had resting pulse rate >120 diagnosed as tachycardia and 1 girl had resting pulse 42 diagnosed as bradycardia. All these were referred for further diagnostic work up.

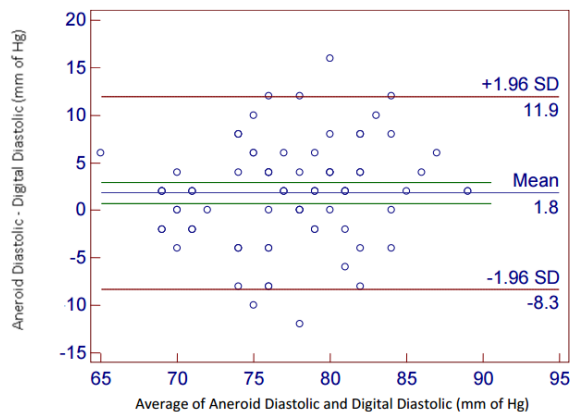
**Table-1: Mean blood pressure value**

Instrument Type	SBP mm of Hg (Mean±2SD)	DBP mm of Hg (Mean±2SD)
Digital	108.92±15.14	76. 20±12.25
Aneroid	109.66±16.81	78.02±14.35

SBP= Systolic Blood pressure; DBP= Diastolic Blood Pressure



Bias 0.74 ± 5.0



Bias 1.820 ± 5.158

The range of systolic BP was 90 to 130mm of Hg (108.92+15.14) and 90 to 130 mm of Hg (109.66+16.81) by digital and aneroid apparatus respectively .The range of diastolic BP was 62 to 88 mm of hg (76.20+12.25) and 68 to 90 mm of hg (78.02+14.35) by digital and aneroid BP apparatus.

The difference between the mean of all aneroid and digital systolic BP reading was within 5 mm in 54.29%, between 5 to 10 mm in 22.25% and more than 10 mm in 2.67%.The difference for diastolic BP reading was within 5 mm in 55.18%, between 5

to 10 mm in 19.58% and more than 10 mm in 4.45%.

By Bland-Altman analysis, the amount of bias between mean systolic blood pressure by aneroid and digital devices was 0.74(-9.0-10.5) and amount of bias between mean diastolic blood pressure by aneroid & digital devices was 1.82(-8.3-11.9).

## DISCUSSION

In this study BP measurements by aneroid and LED sphygmomanometer were compared and no clinically significant difference was found between the two. On reviewing literature, not much data exists for comparison of aneroid and digital manual sphygmomanometer alone. There are many studies which compare different BP measuring apparatus simultaneously- mercury sphygmomanometer with aneroid device, comparing digital pressure gauge with mercury and aneroid devices. From this study it was found that the amount of bias for mean systolic BP was 0.74(-0.9-10.5) and for diastolic BP was 1.8(-8.28-11.93) which is hardly significant clinically. Two US studies<sup>4, 5</sup> have investigated the difference between BP measurements obtained with aneroid and mercury sphygmomanometers. The first study<sup>4</sup> compared the two measurement techniques in 727 individuals participating in the National Health and Nutrition Examination Survey (NHANES) and found systolic BP to be minimally higher with the aneroid sphygmomanometer in children aged 8 to 17 years. In the other study, Shah<sup>5</sup> and colleagues conducted a comparison of aneroid and mercury BP monitors among 193 participants in the SEARCH for Diabetes in Youth Study and found no difference between the two methods in the mean systolic BP, while the diastolic BP was slightly lower with the aneroid monitor and they suggested +1.8 correction factor. Another study done by Ma Y et al has shown no clinically significant difference in between mercury and aneroid devices<sup>6</sup>. One study from Iceland compared aneroid and oscillometric BP demonstrated comparable systolic readings and low mean diastolic BP readings by oscillometric device<sup>8,9</sup>.

In the present study, aneroid and digital LED sphygmomanometer were compared and it was found that the amount of bias for mean systolic BP was 0.74(-0.9-10.5) and for diastolic BP was 1.8(-8.28-11.93) which is clinically non significant. Both the apparatus are widely used in clinical settings and agreement between readings makes it easy to use them interchangeably.

During the study 4 students were detected accidentally with tachycardia and bradycardia that were otherwise asymptomatic and were sent for further work up. This emphasizes the need for routine health check up of asymptomatic youth. 4 students were overweight and 2 were obese as per their BMI. This type of routine health check up practice can be utilized for sensitization regarding healthy food and life style habits.

A relatively small number of BP measurements and single reading may be viewed as a potential limitation of this study. Apparatus results were not compared when BP was high which can also be a limitation.

## CONCLUSION

The systolic and diastolic BP measured by aneroid and LED manual BP apparatus were comparable and can be used interchangeably in daily clinical practice.

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