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ASSESSMENT OF BLOOD PRESSURE WITH THREE DIFFERENT BLOOD PRESSURE APPARATUS (MERCURY, DIGITAL , ANEROID)

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Abstract

Introduction- Hypertension is a prominent risk factor for the onset of cardiovascular disease and is a significant contributor to global morbidity and mortality. Traditionally, the first step in managing hypertension is to make a diagnosis based on many readings of blood pressure taken in a clinic or office. The potential consequences of inaccurate blood pressure measurement include the risk of misdiagnosis and subsequent administration of either inappropriate or inadequate therapy. Such outcomes have significant ethical issues and can also impact public health.

Objective: The objective of this study is to evaluate the accuracy of blood pressure measurements using three distinct blood pressure devices.

Method: The methodology involved the recruitment of 100 participants who were between the ages of 18 and 26 and had a normal body mass index (BMI), in accordance with the established inclusion criteria. Three separate devices were utilized to measure blood pressure, and the resulting data were documented.

Result: There was no statistically significant difference in systolic blood pressure (SBP) measurements when comparing the use of digital blood pressure apparatus to mercury-based apparatus, mercury-based apparatus to aneroid apparatus, and digital blood pressure apparatus to aneroid apparatus. Nevertheless, there exists a notable distinction in the readings of Digital and Aneroid devices for measuring diastolic blood pressure (DBP). There is no statistically significant difference observed in the diastolic blood pressure (DBP) values obtained with the other two instruments.

Conclusion: The statistical analysis conducted on the measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP) obtained using mercury, aneroid, and digital devices leads to the conclusion that there is no significant difference among these measurement methods. The statistical significance of the DBP findings in the Digital versus Aneroid comparison indicates that the experimental hypothesis is partially accepted.

Key Words: Digital BP Apparatus, Mercury BP Apparatus, Aneroid BP Apparatus, BP measurement.

Introduction:

Blood pressure refers to the force exerted by circulating blood on the walls of blood vessels. The generation of pressure is initiated by the myocardial contraction, which propels blood from the cardiac chambers and into the vasculature. This concept exhibits a greater emphasis on mechanics rather than biochemistry. *Https://Med.Libretexts.Org/Bookshelves/Anatomy_and_Physiology/Anatomy_and_Physiology_(Boundless)*, (2015)

Blood pressure measures exhibit sensitivity, since their accuracy can be influenced by various factors such as environmental conditions, subject behavior, measuring techniques, and the instruments employed for measurement. Additionally, the presence of an observer further necessitates the implementation of a standardized measurement methodology in order to mitigate potential mistakes in blood pressure assessment. (Tolonen et al., 2015)

The progressive discontinuation of mercury sphygmomanometers is mostly driven by environmental considerations rather than technological advancements. Despite being widely recognized as the "gold standard" for routine clinical assessment, the use of mercury is being phased out due to environmental concerns.(Pickering, 2003)

The aneroid and digital devices are frequently employed as substitutes for mercury sphygmomanometers. The present study was conducted to evaluate blood pressure measurements using three distinct blood pressure devices.

Methodology:

A total of 100 participants, ranging in age from 18 to 26 years and with a normal body mass index (BMI) between 18.5 kg/m^2 and 24.90 kg/m^2, (Guimarães et al., 2008; Zhu et al., 2004) were included in the study. Participants were also required to have normal body temperature, in accordance with the inclusion criteria. Three separate apparatus were utilized to test blood pressure and the recorded measurements were collected on data collection form. Participants who exhibited negativity on any question on the Physical Activity Readiness Questionnaire (PAR-Q), individuals who identified as smokers or diabetics (Campell et al., 1994; Handler, 2009), pregnant women, and those who had been diagnosed with or had a history of musculoskeletal, cardiovascular, pulmonary, neurological, or systemic diseases that could potentially impact the results of the study were eliminated from the sample.

To induce a state of relaxation, a 5-minute period of rest was provided prior to the commencement of the initial reading. The individual assumed an erect posture, with their upper arm positioned at the level of the heart and their feet resting flat on the floor. Unnecessary garments that have the potential to impede the proper placement of the blood pressure cuff or restrict blood circulation in the arm were eliminated. The cuff was securely fastened around the arm, and an index line was put in place to ascertain whether the arm circumference falls within the designated range.

The participants were assigned to the three groups in a random manner using the chit method.

Three readings were obtained using each device, with a time interval of 2 minutes between each reading. A further interval of 5 minutes was allocated for rest, after which another round of measurements was conducted.

Three readings were obtained using a digital device during a two-minute interval, following which the participants were instructed to relax for a duration of five minutes. Subsequently, blood pressure was assessed using a Mercury sphygmomanometer. Three measurements were once again collected within a two-minute interval, using the identical measurement protocol and Aneroid instrument, for the same patient. All of the readings were recorded on the data collecting form.

Figure 1: Instruments used during blood pressure measurement

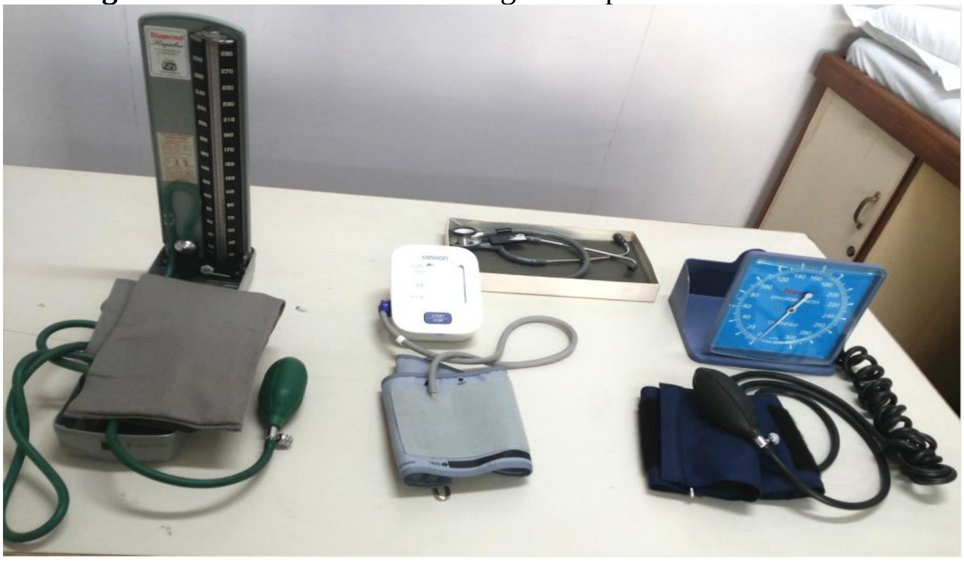
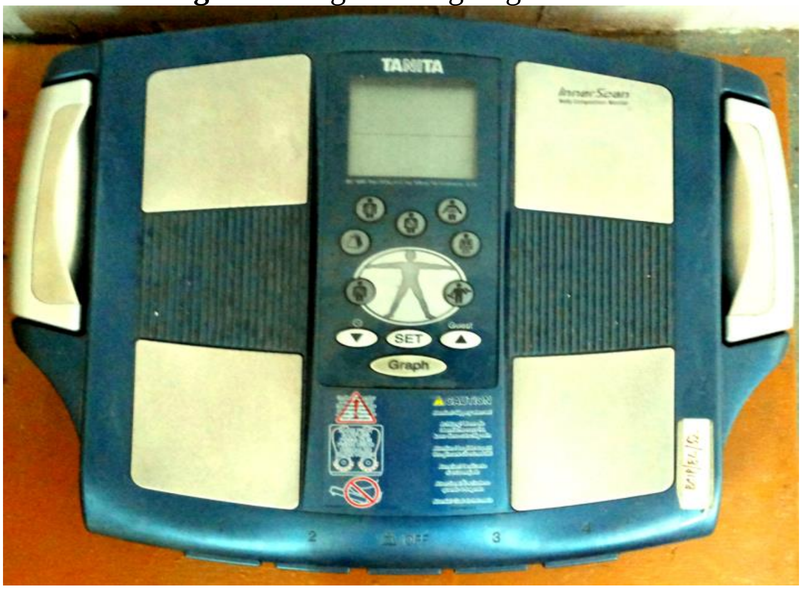


Figure 2: Digital Weighing machine



Results-

Our study revealed no statistically significant difference in systolic blood pressure (SBP) measurements when comparing the use of digital blood pressure equipment with mercury-based apparatus, mercury-based apparatus with aneroid apparatus, and digital blood pressure apparatus with aneroid apparatus. Nevertheless, there exists a notable distinction between the digital and aneroid diastolic blood pressure (DBP) measurements. There is no statistically significant difference observed in diastolic blood pressure (DBP) values obtained with the other two devices.

Table 1 : Baseline Characteristics

Characteristics	Measures	N. of subject (n=100) (%)
Age	Mean (SD)	21 (1)
Gender	Male	13 (13%)
	Female	87 (87%)
Height	Mean (SD)	159.12 (6.01)
Weight	Mean (SD)	56.02 (8.01)
BMI	Mean	23.25 (2.12)
Temperature	Mean	92.3 (2.1)
W.C	Mean	81.1 (8.1)
H.C	Mean	91.23 (9.01)

Table 2: Mean and SD of SBP and DBP with different BP apparatus

	SBP		DBP	
APPARATUS	**MEAN**	**SD**	**MEAN**	**SD**
DIGITAL	112.6	111.36	75.04	7.41
MERCURY	113.05	8.04	73.45	6.08
ANEROID	111.08	8.06	72.85	5.65

Table 3: p- value (By t-test) between the groups

Apparatus	SBP	DBP
Digital Vs Mercury	0.58	0.10
Mercury Vs Aneroid	0.08	0.08
Digital Vs Aneroid	0.26	0.02

Discussion

The objective of this study is to evaluate blood pressure measurements using three distinct apparatuses: Mercury, Digital, and Aneroid.

The findings of our study revealed no significant statistical distinction in the measurement of systolic blood pressure (SBP) when comparing digital blood pressure apparatus to mercury-based apparatus, mercury-based apparatus to aneroid apparatus, and digital blood pressure apparatus to aneroid apparatus. While there is a notable distinction between the digital and aneroid diastolic blood pressure (DBP) readings, there is no statistically significant difference observed in DBP measurements obtained with the other two devices. In a study conducted by Sigridur B. Eliasdottir, Steinthorodottir, and colleagues (Eliasdottir et al., 2013) , the researchers examined the comparability between aneroid and oscillometric measurement methods in children. This research was conducted as a population-based, cross-sectional investigation of blood pressure (BP) in children. In this study, two measurements were obtained using an aneroid apparatus, while an additional two measurements were obtained using an automatic oscillometric apparatus. The author observed no statistically significant difference in average systolic blood pressure (SBP) between the two procedures. However, it was revealed that the oscillometric method resulted in much lower diastolic blood pressure (DBP) compared to the other methodology. The author's conclusion indicated that the systolic blood pressure (SBP) was found to be higher when measured using the oscillometric approach. However, there was no statistically significant difference noticed in the mean values of all SBP readings acquired with the aneroid apparatus and the oscillometric blood pressure monitor.

Additional studies that provide support for the findings of our investigation include the research conducted by Yulia Sofiatin and Rully M.A. Roesli, which examined the comparison of blood pressure measurements using mercury, aneroid, and digital sphygmomanometers in a community setting (Hamied et al., 2015). Blood pressure (B.P.) was taken on the dominant arm while the participant was in a seated position. The measurement was completed using three different apparatus:

mercury, aneroid, and digital. Each device was used twice for the measurement. The study's findings indicated that there were no statistically significant differences in average blood pressure measurements between digital and mercury devices (p=0.71), digital and aneroid devices (p=0.46), and aneroid and mercury devices (p=0.71). The utilization of this digital and aneroid device has the potential to serve as a substitute for mercury apparatus within a community environment.

Susan Buchanan et al, (Buchanan, 2009), conducted a comparative analysis of the oscillometric apparatus with mercury and aneroid devices. The oscillometric equipment served as the gold standard in this study. In comparison to the oscillometric method, the aneroid method tends to underestimate blood pressure readings, while the mercury method tends to overestimate them. The author's conclusion suggests that, with good maintenance, the alternative technologies exhibit comparable or superior levels of accuracy.

In their study, Gill, Ala, and Gurgel et al (Gill et al., 2004) examined the accuracy of aneroid blood pressure (BP) recording using both digital and mercury apparatus. The blood pressure tests were conducted on a sample of 400 adult individuals. The researchers reached the conclusion that the aneroid apparatus exhibited a minor tendency to underestimate measurements, in contrast to the digital and mercury devices which demonstrated a measurement underestimation of around 32%. Nevertheless, it is a viable substitute for mercury equipment under tropical environmental circumstances.

The objective of the study conducted by Johanson and Julaa, et al (Johansson et al., 2014) was to investigate the efficacy of oscillometric blood pressure measurement and auscultatory blood pressure measuring techniques for evaluating blood pressure levels in the general population. The study included a sample of 448 individuals from the adult population, specifically those aged 25 to 74 years. The Osillometric Blood Pressure (OBP) and Auscultatory Blood Pressure (ABP) were concurrently assessed on four occasions. The OBP measurements were initiated randomly from either the right or left arm, and the devices were thereafter switched between hands after two measurements. The author reached the conclusion that there was a similarity in the findings obtained from Oscillometric Blood Pressure and Auscultatory Blood Pressure measurements.
One of the limitations of this study is the small sample size. The potential sources of inaccuracy encompass the utilization of an unsuitable cuff size and the excessively quick deflation of the cuff. The recorded blood pressure readings could not accurately reflect the subject's actual blood pressure due to the presence of the white coat effect. Potential sources of mistake in the evaluation process may also encompass the utilization of manual instruments, as well as the evaluator's auditory and visual sensitivities.
Potential Areas for Future Research: Additional studies should be conducted on various age groups, such as children and geriatric populations, to explore similar patterns.
Research can be conducted to compare the outcomes following the implementation of exercise regimens. Additionally, research can be conducted to compare blood pressure measures among individuals diagnosed with cardiovascular, neurological, and systemic disorders/conditions with different devices.

Conclusion:
The findings indicate that there is no statistically significant difference in the measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP) when using mercury, aneroid, and digital devices. The statistical significance of DBP readings in Digital versus Aneroid devices indicates that the experimental hypothesis is partially accepted.

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