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**Original Research Article**

# Comparative Study between Cardiac Monitor & Mercury Sphygmomanometer in Efficiency & Accuracy of Reading at El-mek-Nimer Hospital University-Shendi University-2020

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**Abstract:** ***Background:*** Recording blood pressure is important part of long term epidemiological study which has confirmed the importance of high blood pressure as risk factor in cardiovascular disease the Objectives of this study was to evaluate difference of reading of blood pressure between cardiac monitor And mercury sphygmomanometer from arm site. ***Method:*** This was analytical comparative study was conducted in the Sudan, river Nile state, Shendi town, in the Elmek Nimer two devices (mercury, cardiac monitor)&stethoscope were used to measure blood pressure From the upper arm, the data was analyzed by using statistical package of social science (SPSS version 22). ***Results and Conclusion:*** The study showed that, cardiac monitor more accurate in measuring blood pressure rather than mercury sphygmomanometer. ***Recommendation:*** The study was recommended that: All health team members should be used cardiac monitor rather than mercury sphygmomanometer blood pressure, so that they have to recheck reading of mercury sphygmomanometer blood pressure before it used.

**Keywords:** Patient, Comparison, blood pressure, cardiac monitor, efficiency, Elmek Nimer.



## 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 noninvasive methods to measure blood pressure. 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 (Khyati M Kakkad *et al*., 2016).

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. Automated oscillometric device is found very helpful for home measurements but needs close supervision (Ostchega Y *et al*., 2011, Amy S. Shah, Lawrence M. Dolan *et al*., 2012, Ma Y, Temprosa M, Fowler S *et al*., 2009).

Early diagnosis of hypertension is essential for timely management and prevention of its complication. Accuracy of the BP measurement plays a crucial role in curbing the menace of hypertension and to decrease associated morbidity which a matter of great public health concern High blood pressure is ranked as the third most important risk factor of attributable burden of disease in south Asia (2010) and the prevalence for hypertension in India was 29.8% (Deshpande S *et al*., 2014, Lim SS, Vos T *et al*., 2010).

There are three non-invasive modalities commonly used to check BP throughout the world such as manual mercury sphygmomanometer, aneroid meter

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and the automated oscillometric device (digital). The manual mercury sphygmomanometer is considered to be the gold standard. 9 Mercury sphygmomanometers had been used by healthcare professionals over the last 100 years in both hospital and ambulatory settings as a gold standard (Ogedegbe G and Pickering T, 2010, Kakkad K, 2016).

An approach is necessary to identify the alternative device which is easier and competent in measuring BP. Non mercury sphygmomanometers like aneroid and more recently, digital ones have replaced the use of traditional mercury instruments in many settings. This device translates arterial pressure into oscillometric wave and with system built algorithm display readings (Kakkad K *et al*., 2016).

Accuracy of blood pressure (BP) measurement in clinical settings is one of the most concerns despite of considerable promotion in measurement techniques. Manual BP measurement can be so accurate when using a device such as the mercury manometer which is similar to the mean awake ambulatory blood pressure (AABP) (Mirdamadi A, Etebari M 2017).

Selection of an accurate, validated BPMD is important for assessing BP as these devices will provide accurate and reproducible measurements. Accurate BP measurements are essential to manage hypertension, as imprecise measurement can significantly affect diagnosis and treatment. In one study, the diagnostic classification of > 50% of people changed when their BP was measured with a standardized method rather than a usual clinical method (WHO 2020).

The accuracy of these devices is fundamental to health care quality and safety and scientific research, electronic devices should be validated both technically and clinically. Validation is typically conducted by determining the mean difference in results between the device tested and a control standard for a given number of tests. The control standard BP is typically obtained with a manual device by two independent observers, who simultaneously determine the systolic and diastolic BP of each person with a double-headed stethoscope. Accuracy validation testing should be conducted independently by institutions that are certified or identified as capable by relevant regulatory entities and should be based on standard validation protocols. Practical issues have been raised in LMICs with regards to phasing out mercury devices, choosing appropriate BP devices, identifying inexpensive devices that have been validated, providing periodic training for health care professionals and checking devices regularly for accuracy (E. O'Brien, G *et al*., 2018, G. Stergiou, P *et al*., 2019).

## MATERIAL AND METHODS

**Study design:** this was a clinic-based cross-sectional analytical study.

**Study area:** this study was done in Sudan, River Nile state, in Shendi city which is located 172 km north to Khartoum, The town consider as center of jallyeen tripe as well as other tribes like shaigia/Hassania and other tribes. The majority of population profession**,** it has three big hospitals, Shendi teaching hospital, out patients, al mek nimer university hospital, Military hospital. All have different department which provide good health services for Shendi area.

**Study setting:** In almek nimer was established 2002. And it consists of surgical, pediatric, and obstetrical department. ENT, renal, ophthalmic, dental, and medical units which compose of tow ward male and female with at least 38 beds, nurses are working in this unit. There are also major and minor theater, emergency room and CCU, ICU, and dialysis room. There is also blood bank, laboratory, and pharmacy. The hospitals have more than 200beds, and the nursing staff rotated among the units routinely, they were about 125 nurse.

**Study population:** It is include all patients who admitted to ICU Medicine and CCU during time of the study.

**Inclusion Criteria**

- Stable patients admitted to ICU Medicine and CCU.
- Patients agree to participate.

**Exclusion Criteria**

- Critically ill patients.
- Patients in general ward.
- Patients agree to participate.

**Sampling:**

**Sampling technique:** Convenience sampling where used.

**Sample size:** (50) patients were admitted to ICU Medicine, CCU**.**

**Data collection tools:** The data was collected by using check list to record the reading of electronic and manual reading blood pressure, cardiac monitor BP prop was used to record electronic reading of blood pressure and mercury sphygmomanometer and stethoscope were use to record indirect blood pressure reading.

**Data collection technique:** Data was collected in 3 weeks during the day, the researcher record blood pressure reading from the cardiac monitor then manual reading by mercury sphygmomanometer was taken and compared, this procedure was done only among stable patient in consideration.

**Measurement of Blood Pressure**

Standard operating procedure for measuring blood pressure was followed. It was ensured that the study participants were relaxed at-least for 10–15 min

before measurements and were seated with legs uncrossed and back supported and arm was supported at heart level before the measurements. Cuffs of appropriate sizes were used. Blood pressure of each participant was measured twice by each instrument and average of the two readings was noted down in a data entry form. All the individual blood pressure measurements of the study participants were repeated at 30 second intervals

**Data Management**

The data was coded by using master sheet then analyzed by using statistical package of social science "SPSS version 20".

Different statistical major was used "frequency, percentage, means, chi test" p value was consider significant if less than 0.05, then percentage in forms of tables.

**Ethical Consideration**

Approval was taken from the research board of the faculty, agreement was taken from the original director of the hospital and the head nurse to conduct the study ,verbal consent was taken from the participant after explanation the purpose of the study and the data should be confidential, they have chance to refuse.

## RESULT

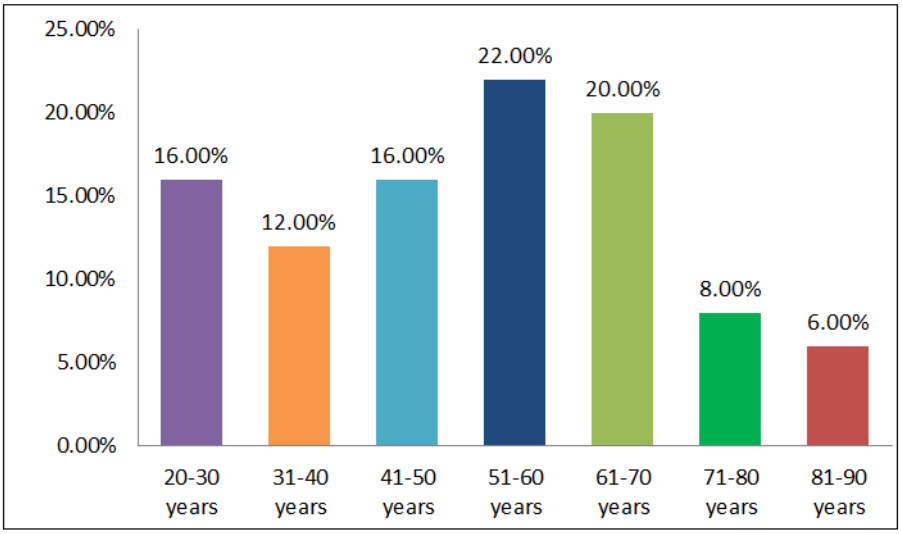


**Figure 1: Study group according to Age Patient (N=50)**

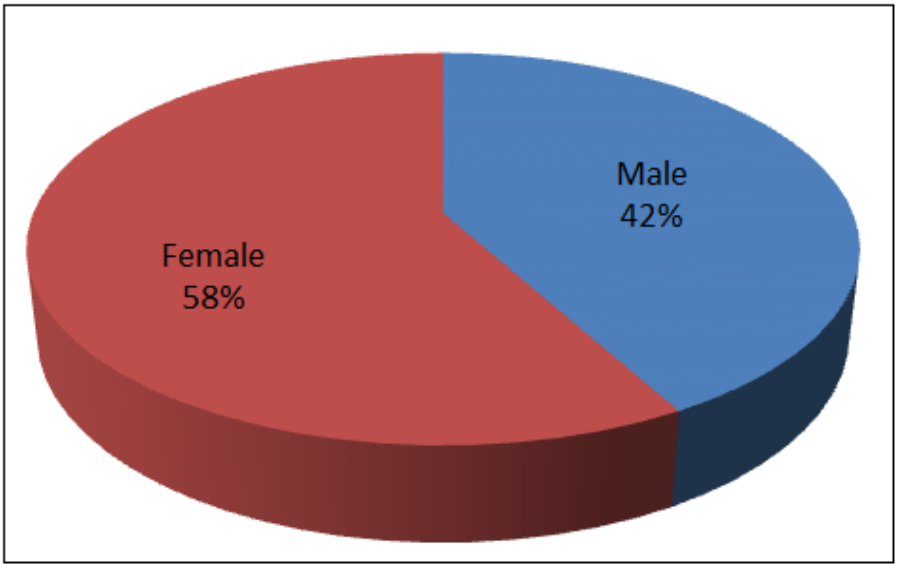


**Figure 2: Study group according to gender Patient (N=50)**

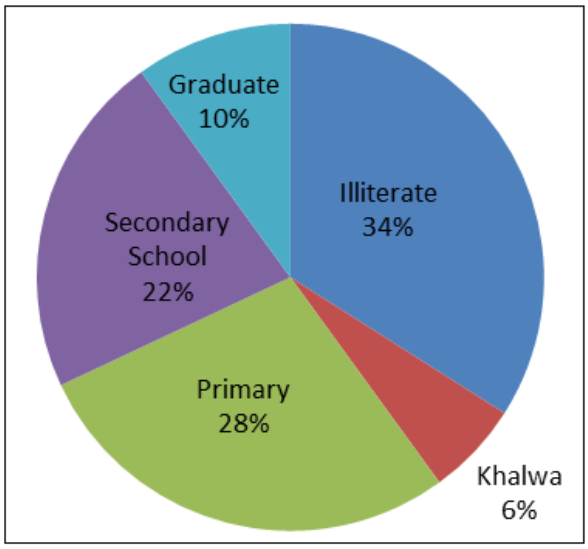


**Figure 3: Study group according to education level (N=50)**

**Table 1: Study group according to Unit admission**

| **Unit** | ***Frequency*** | ***Percentage*** |
|---|---|---|
| **CCU** | 22 | 45% |
| **ICU medicine** | 16 | 30% |
| **ICU surgery** | **12** | **25%** |
| **Total** | **50** | **100%** |

**Table 2: Compare means Between Monitor Reading (Systolic pressure) and Monitor Reading (Diastolic pressure)**

| ***Items*** | ***Monitor Reading- Systolic pressure*** | ***Monitor reading Diastolic pressure*** |
|---|---|---|
| **Mean** | 139.40 | 84.30 |
| **Std. Deviation** | 37.055 | 23.343 |
| **Total** | **50** | **50** |

**Table 3: Compare means Between Sphygmomanometer (Systolic pressure) and Sphygmomanometer Monitor (Diastolic pressure)**

| ***Items*** | ***Sphygmomanometer Monitor - Systolic pressure*** | ***Sphygmomanometer Monitor -Diastolic pressure*** |
|---|---|---|
| **Mean** | 82.38 | 135.74 |
| **Std. Deviation** | 19.110 | 33.507 |
| **Total** | **50** | **50** |

**Table 4: Comparison between the Monitor Reading Systolic pressure and Sphygmomanometer- Monitor Systolic pressure**

| ***Comparison*** | **Paired Differences** | | | | | **Sig** |
|---|---|---|---|---|---|---|
| | **Mean** | **Std. Deviation** | **Std. Error Mean** | **95% Confidence Interval of the Difference** | | |
| | | | | **Lower** | **Upper** | |
| **Monitor Reading Systolic pressure * Sphygmo Monitor Systolic pressure** | **3.660** | **19.519** | **2.760** | **-1.887** | **9.207** | **.002** |

**Table 5: Comparison between the Monitor Reading Diastolic pressure and Sphygmomanometer- Monitor Diastolic pressure**

| ***Comparison*** | **Paired Differences** | | | | | **Sig** |
|---|---|---|---|---|---|---|
| | **Mean** | **Std. Deviation** | **Std. Error Mean** | **95% Confidence Interval of the Difference** | | |
| | | | | **Lower** | **Upper** | |
| Monitor Reading Diastolic pressure *Sphygmo Monitor Diastolic pressure | **1.920** | **14.003** | **1.980** | **-2.060** | **5.900** | **.023** |

## DISCUSSION

Accurate Blood pressure measurement is needed For medical diagnosis, treatment & prevention of disease, blood pressure always given as these two Numbers, the systolic & diastolic pressure, it measured By using mercury sphygmomanometer and cardiac monitor.

The result of the study represented that with less than quarter (22%) study group of age between 51-60 years, more than half (58%)of them was female, more than one third (34%) of them was illiterate, less than half (45%) of them was admitted in CCU.

The result of This study reflected that the mean of systolic blood pressure in mercury sphygmomanometer was (82,38mmHg) while the mean for standard deviation of systolic blood pressure was (190,10 mmHg) also the mean mercury diastolic (135,74mmHg) while the standard deviation (33.507mmHg), the mean cardiac monitor systolic pressure was (139.40mmHg) while the standard deviation systolic pressure was (37,055mmHg) ,also the cardiac monitor mean diastolic pressure was (84,30mmHg) while standard deviation of diastolic pressure was (23.343 mmHg) This result corresponding with previous e study done in Asian which concluded that (evaluated that automated oscillometric BP measuring devices are simple to operate, free from environmental toxicity. Readings of these devices are comparable to mercury devices but readings of SBP are slightly higher as compared to mercury devices (Ravindra Wadhwani *et al*., 2018) in addition to the present data agree with study done by WHO which reported that(Now, mercury is recognized as a substance producing significant adverse neurological and other health effects, with particular concerns expressed about its harmful effects on infants and unborn children) (WHO, 2020) another hand the present data disagree with study done in Indian which stat that( such evidences are scanty in Indian context, where there is an obvious need of more feasible and inexpensive instruments because of large population size, increased poverty and decreased tendency to seek institution based medical care) (A'Court C, Stevens R *et al*., 2015).

The result of this study explained that compare between diastolic pressure in monitor and sphygmomanometer ,mean reading of diastolic pressure 1.920mmHg, standar deviation 14.00, std error 1.980, with statistical significant value (.023) while in systolic pressure mean reading 3.660 std deviation 19.519 std error 2.760. with statistical significant value (.002) this result agree with previous study conducted in ARYA Atheroscler which reported that (SBP in patients below 60 years was significantly more in manual method compared to automatic method (P = 0.016), but not for cases over 60 years (P = 0.090), and DBP shows a significant difference between two methods in patients below 60 years too (P = 0.004) (Mirdamadi A, Etebari M, 2017).

## CONCLUSION

Present study evaluated that automated oscillometric BP measuring devices are simple to operate, free from environmental toxicity. Readings of these devices are comparable to mercury devices but readings of SBP are slightly higher as compared to mercury devices. They may be considered as a primary tool to detect high BP without medical help and consequently helpful in early diagnosis of diseases. Moreover, automated apparatus found to be statistically similar in detecting hypertension when compared to sphygmomanometer.

## RECOMMENDATION

All health team members should be used cardiac monitor rather than mercury sphygmomanometer blood pressure, so that they have to recheck reading of mercury sphygmomanometer blood pressure before it used.

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