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Original Article

Comparative Analysis of Vital Signs Measured Using a Smartwatch and Conventional Medical Devices: A Cross-Sectional Study on Digital Innovation in Healthcare

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ABSTRACT

Background: Smartwatch devices that leverage digital technology for blood pressure (BP) measurement are increasingly being recognized as valuable instruments for managing hypertension and heart failure. Continuous blood oxygen saturation (SpO_2) monitoring is critical for patients experiencing low blood oxygen levels. The advent of smartwatches has introduced an innovative method for monitoring these levels; however, it is essential to understand their accuracy and limitations to determine their suitability for clinical applications.

Material and Methods: A total of 70 patients, consisting of 27 males and 43 females with a mean age of 28.7 ± 13.3 years, were recruited for this study. Each subject underwent observed single measurements using a smartwatch device, which was subsequently compared to readings taken by an auscultatory sphygmomanometer and fingertip pulse oximetry. Both monitoring devices for BP measurements were positioned concurrently on the same arm throughout the monitoring period.

Results: The analysis indicated that the systolic values of the infrared BP monitor recorded on smartwatches displayed a mean difference of 5.82 mmHg compared to those obtained by auscultatory sphygmomanometry. Similarly, diastolic values exhibited a mean difference of 5.62 mmHg. Furthermore, the study revealed a mean difference of -0.67% between the SpO_2 readings from smartwatches and those acquired from fingertip pulse oximetry.

Conclusion: The Fire-Boltt smartwatch has demonstrated efficacy in monitoring and managing BP and SpO_2, with recorded values closely aligning with those derived from standard clinical methodologies. These devices possess significant potential for telemetric treatment monitoring, enhancing patient care in outpatient settings.

Keywords: Blood pressure, Oxygen saturation, Smartwatch

Introduction:

Hypertension represents a significant risk factor for heart disease. According to current clinical guidelines, blood pressure (BP) measurements should be conducted utilizing a validated auscultatory or automatic upper-arm sphygmomanometer [1]. Traditionally, BP measurements were performed in a clinical environment; however, recent evidence indicates that out-of-office BP measurements yield superior prognostic information compared to office-based measurements alone [2,3]. Accurate measurement of BP is crucial for the diagnosis, management, and prognosis of individuals diagnosed with hypertension. The auscultatory technique, employing a stethoscope in a clinical setting, remains the gold standard for BP measurement [4,5].Various sphygmomanometers are commonly used, including mercury, aneroid, and electronic models. The mercury sphygmomanometer has mainly been phased out due to environmental concerns related to mercury pollution and has been replaced with electronic or aneroid devices [6]. The clinical importance of out-of-office BP measurement has been emphasized repeatedly, as it provides more meaningful prognostic data than office readings alone. Moreover, self-monitoring of BP can enhance hypertension awareness and encourage adherence to treatment protocols [7].

The emergence of smartwatch devices that utilize digital technology to measure BP has introduced a convenient option for managing hypertension and heart failure [8]. The continuous monitoring of SpO_2 levels is essential for patients with low blood oxygen saturation. Thus, smartwatches have provided a novel approach to patient monitoring [9,10]. Nonetheless, it is critical to evaluate the accuracy and limitations of these devices to ensure their suitability for clinical use. The primary objective of this study is to rigorously assess the efficacy of such devices before their implementation in patient care.

MATERIAL & METHODS

A total of 70 consecutive patients, comprising 27 males and 43 females, with a mean age of 28.7 ± 13.3 years, were enrolled in this study. Participants were advised to select a chair with adequate lumbar support to promote optimal comfort and relaxation, ensuring their feet remained flat on the floor. It was recommended for each participant to engage in a five-minute rest before initiating the testing procedures. BP measurements were obtained utilizing an auscultatory sphygmomanometer and a stethoscope. The cuff was applied to the upper arm, positioned approximately 1 inch above the elbow, ensuring a snug fit without excessive tightness.

The stethoscope was placed over the brachial artery, just below the cuff 's lower edge, to facilitate accurate auscultation of the pulse. The cuff was then inflated rapidly by either squeezing the bulb or activating the appropriate button on the automated monitor, reaching a pressure approximately 30 mmHg above the point at which the pulse became inaudible. The pressure in the cuff was gradually released by opening the valve or disengaging the button. It should decline at a rate of 2-3 mmHg per second. The first pulse sound detected indicates systolic pressure, and monitoring is continued until the sounds cease altogether, indicating diastolic pressure. Both systolic and diastolic pressures were meticulously recorded, along with the date, time, and arm utilized for the measurements. Patients who exhibited signs of nervousness were advised to wait for several minutes before repeating the measurement.The readings were interpreted according to standard BP ranges, with normal blood pressure typically around 120/80 mmHg. Patients identified with elevated BP (hypertension) were advised to seek further monitoring and medical attention. The BP readings were explained to every individual, along with any necessary recommendations. The equipment was calibrated, and all instructions provided with the BP monitor or cuff were meticulously followed.

Subjects underwent observed single measurements using a smartwatch device, which were compared to those obtained from the auscultatory sphygmomanometer and fingertip pulse oximetry. Monitoring devices for BP measurements were worn simultaneously on the same arm throughout the monitoring period.

RESULT

Our analysis revealed that the systolic measurements obtained from infrared BP monitors integrated within smartwatches exhibited a mean difference of 5.82 mmHg compared to readings from an auscultatory sphygmomanometer. Similarly, the diastolic measurements demonstrated a mean difference of 5.62 mmHg. Furthermore, we identified a mean difference of -0.67% in oxygen saturation readings between smartwatches and fingertip pulse oximeters [Table 1].

Table 1: Comparison of manual versus smart watch blood pressure measurements

Parameters	Manual BP mean values	Smartwatch BP mean values	Difference
Systolic BP mean value (mmHg)	117	122.8	5.82
Diastolic BP mean value (mmHg)	68.5	74.2	5.62
Saturation mean value	97.5%	96.8%	0.67 %

BP: Blood Pressure

DISCUSSION

The adoption of smartwatches for measuring BP is anticipated to rise considerably and rapidly. A novel method for BP measurement based on a photoplethysmography algorithm, implemented in conjunction with a smartwatch, has received approval as a medical device. The objective of this study was to evaluate the feasibility and measurement stability of smartphone-based BP measurement. The results indicate that the Fire-Boltt smartwatch is accurate for monitoring vital signs. Regarding BP assessments, the smartwatch exhibited a mean difference of 5.6 mmHg compared to conventional cuff readings. Additionally, while the device satisfied the accuracy standards established for SpO_2 measurements, it displayed a mean deviation of 0.67% relative to the saturation values obtained from a standard pulse oximeter. There is a lack of awareness regarding previous studies on the Fire-Boltt smartwatch that would permit a comparative analysis of the findings presented in this study. Nonetheless, we have identified three research investigations conducted by a Dutch research group focusing on the BodiMetrics Performance Monitor, which is marketed in Europe under the name Checkme.[11-13] Weenk M *et al.*[12] conducted a survey that assessed the systolic blood pressure (SBP) measurements obtained from the BodiMetrics Performance Monitor compared to those recorded from a reference automated cuff, involving a sample of 37 outpatients in a supine position. The results of this study indicated an average absolute difference of approximately 6.7 mmHg (SD = 5.4) in the supine position. Notably, the average absolute difference reported in their study exceeds the difference observed in our study, which was recorded at 5.8 mmHg. The Institute of Electrical and Electronics Engineers (IEEE) has introduced an alternative validation protocol specifically designed for cuffless BP monitors to address concerns about reliance on BP calibration. This protocol mandates that these devices achieve the same level of accuracy as stipulated by the ANSI/AAMI/ISO standards applicable to cuff-based devices. However, it differentiates itself by incorporating validation measurements conducted after the induction of artificial modifications to BP following the initial calibration. This methodology ensures accuracy across a diverse range of BP values. Moreover, the IEEE protocol necessitates that validation measurements be executed after an extended timeframe, from weeks to months post-initial calibration, to evaluate the calibration's validity over time. It is pertinent to highlight that the current study did not involve the induction of varying BP levels, nor did it assess time-dependent changes in accuracy. A post hoc analysis was performed to examine the

potential impact of variations in BP, as compared to the calibration value, on the accuracy of the Fire-Boltt device. This analysis compared the discrepancies between the reference values and the Fire Boltt SBP measurements alongside the differences between the reference values and the calibration value. The results revealed a significant moderate correlation between these two absolute differences, indicating that the accuracy of the Fire-Boltt device decreases when utilized at pressures that diverge from the calibration value. These findings necessitate further validation through a prospective study involving intentional BP alterations among subjects to substantiate any definitive conclusions. Based on the results, we contend that the current calibration process for the Fire-Boltt device has limitations that warrant additional investigation.

CONCLUSION

The Fire-Boltt smartwatch has emerged as a credible device for monitoring and regulating BP and SpO_2 levels, yielding results that closely correspond with those obtained through conventional clinical methods. This technology presents significant potential for telemetric observation and treatment enhancement within an outpatient context.

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REFERENCES

1. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, *et al*. 2021 ESC guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J 2021;42:3227-337.
2. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, *et al*. 2020 international society of hypertension global hypertension practice guidelines. Hypertension 2020;75:1334-57.
3. Williams B, Mancia G, Spiering w, Rosei EA, Azizi M, Burnier M, *et al*. 2018 practice guidelines for the management of arterial hypertension of the European society of cardiology and the European society of hypertension ESC/ESH task force for the management of arterial hypertension. J Hypertens 2018;36:2284-309.
4. McManus RJ, Mant J, Franssen M, Nickless A, Schwartz C, Hodgkinson J, *et al*. Efficacy of self-monitored blood pressure, with or without telemonitoring, for titration of antihypertensive medication (TASMINH4): An unmasked randomised controlled trial. Lancet 2018;391:949-59.
5. Lee HY, Lee DJ, Seo J, Ihm SH, Kim K, Cho EJ, *et al*. Smartphone/ smartwatch-based cuffiess blood pressure measurement?: A position paper from the Korean society of hypertension. Clin Hypertens 2021;27:1-8.
6. Falter M, Scherrenberg M, Dendale P. Digital health in cardiac rehabilitation and secondary prevention: a search for the ideal tool. Sensors 2020;21:12.
7. Kim KI, Ihm SH, Kim GH, Kim HC, Kim JH, Lee HY, *et al.* 2018 Korean society of hypertension guidelines for the management of hypertension: part III-hypertension in special situations. Clin Hypertens 2019;25:19.
8. Lee HY, Shin J, Kim GH, Park S, Ihm SH, Kim HC, *et al*. 2018 Korean Society of Hypertension Guidelines for the management of hypertension: part II-diagnosis and treatment of hypertension. Clin Hypertens 2019;25:20.
9. Verberk WJ, Kroon AA, Lenders JW, Kessels AG, van Montfrans GA, Smit AJ, *et al*. Self-measurement of blood pressure at home reduces the need for antihypertensive drugs: a randomized, controlled trial. Hypertension 2007;50:1019-25.
10. Cappuccio FP, Kerry SM, Forbes L, Donald A. Blood pressure control by home monitoring: Meta-analysis of randomised trials. BMJ 2004;329:145.
11. Datex-Ohmeda, Inc. Biomedical Manuals. Madison, WI, USA: General Electric Company; 2007. Datex-Ohmeda Cardiocap™/5: Technical Reference Manual. Available from: https://biomedicalmanuals.com/wpcontent/uploads/2019/03/ CardioCap-5.pdf. [Last accessed 2024 Feb 15].
12. Weenk M, van Goor H, van Acht M, Engelen LJ, van de Belt TH, Bredie SJ. A smart all-in-one device to measure vital signs in admitted patients. PLoS One 2018;13:e0190138.
13. Ogink PA, de Jong JM, Koeneman M, Weenk M, Engelen LJ, van Goor H, *et al*. Feasibility of a new cuffiess device for ambulatory blood pressure measurement in patients with hypertension: mixed methods study. J Med Internet Res 2019;21:e11164.

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