

Evaluation of the Influence of Skin Phototypes on the Accuracy of a Smartwatch for Blood Pressure and Heart Rate Monitoring

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Wearable devices, such as smartwatches, are increasingly used for remote and continuous monitoring of blood pressure (BP) and heart rate (HR). However, their reliability across different skin phototypes remains uncertain, as photoplethysmography (PPG) signals may be affected by skin pigmentation. This study evaluated the correlation and agreement between smartwatch and sphygmomanometer measurements of systolic BP (SBP), diastolic BP (DBP), and HR across skin phototypes. A total of 48 participants were equally distributed among phototypes II, III, and IV (n=16 each). Measurements were obtained simultaneously, and analyses included Pearson correlation and Bland–Altman methods. Strong correlations were observed for all variables. Stratified analysis showed similar performance across phototypes, with comparable dispersion and no systematic bias related to skin pigmentation. Global results were: SBP ($r=0.957$; bias=2.417 mmHg), DBP ($r=0.972$; bias=1.000 mmHg), and HR ($r=0.919$; bias=1.896 bpm) (Table 1).analysis showed consistent data alignment within the limits of agreement, indicating stable performance across phototypes and supporting the reliability of the smartwatch for remote BP and HR monitoring (Table 1).

Table 1: Pearson Correlation and Bland–Altman Agreement by Skin Phototype

Variable	Phototype II	Phototype III	Phototype IV
SBP <i>r</i> ; <i>p</i> -value	0.987; < 0.001	0.980; < 0.001	0.883; < 0.001
Bias- [mmHg]	1.250	3.385	2.632
DBP <i>r</i> ; <i>p</i> -value	0.989; < 0.001	0.965; < 0.001	0.974; < 0.001
Bias- [mmHg]	0.500	1.883	0.633
HR <i>r</i> ; <i>p</i> -value	0.821; < 0.001	0.950; < 0.001	0.974; < 0.001
Bias- [bpm]	1.255	3.753	0.692