Smartwatches in Clinical Pre-diagnosis: Enhancing Tilt Test Analysis for Prolonged COVID-19 Symptoms

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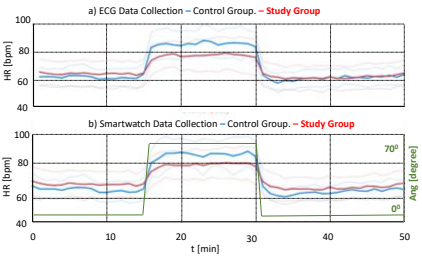
With technological advancements, smartwatches have emerged as multifunctional devices that enable non-invasive real-time collection of biomedical data, continuously monitoring heart rate with optical sensors and determining postural changes with an integrated accelerometer. However, conventional apps face limitations in analyzing heart rate variability (HRV) due to reduced sampling rates. In this context, we developed and validated a specific app for smartwatches, focusing on clinical pre-diagnosis for the "Tilt Test," emphasizing patients with Long-COVID-19 and post-COVID-19. The App focuses on HR measurement and accelerometer analysis to determine body transitions, serving as a basis for HRV analysis in different postural situations, aiming to evaluate the autonomic response of the sympathetic/parasympathetic system. We selected 44 participants based on specific criteria, divided into control and study groups, applying a 50-minute tilt-test protocol with three phases: 15 min. horizontal, 15 min. inclined, and a 20 min. recovery. Throughout the procedure, we collected data simultaneously using ECG as the reference standard and smartwatches positioned on both the wrist and ankle. To ensure app accuracy, we conducted calibration tests, including linear regression and the Bland-Altman test to analyze result concordance. Additionally, we used the Mann-Whitney test to observe potential differences between study groups. Data from the smartwatch were compared with ECG data, showing a high correlation (r=0.98). Concordance corrections were also conducted. Statistical analysis of data collected by both ECG and smartwatch revealed significant differences between study and control groups ($p<0.05$). The App has the potential to enable "at-home tilt-tests," enhancing accessibility to clinical pre-diagnosis through smartwatch use and potentially aiding in daily life activities. The data collection method is particularly useful for detecting Postural Orthostatic Tachycardia Syndrome (POTS) in patients with LongCOVID-19 or post-COVID-19 symptoms.



Data acquisition of Tilt-Test by ECG vs Smartwatch in CG (n= 31) and SG (n=15) participants.