Lab vs. Real-world PPG characterization for blood pressure stratification in healthy individuals

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Introduction: Photoplethysmography (PPG) has recently gained attention for its peculiarity in monitoring the cardiovascular system with wearable sensors. One of the most critical challenges is the estimation of blood pressure (BP) from PPG. Several attempts have been made in this direction, primarily based on laboratory recordings. Real-world recordings can provide more complete information about cardiovascular health by monitoring physiological changes throughout the day. In this work, we analyzed PPG morphological parameters obtained during laboratory and real-world sessions to evaluate their ability to discriminate between low and high BP subjects. **Methods**:Healthy subjects (42±12 years, N = 39) were monitored for 24 hours using a wrist-worn PPG sensor (E4, Empatica, USA). The in-lab session consisted of a 2:30-minute PPG recording, followed by a triple oscillometric BP measurement (Mobil-O-Graph 24h PWA, IEM Gmbh, Germany), based on which low/high BP subjects (N = 13/26, respectively; threshold: 120 mmHg for systolic BP) were identified. The real-world recordings were segmented into wakefulness and sleep using the GGIR open-access software on E4 accelerometer data. A PPG signal quality algorithm was employed to extract high-quality PPG pulses normalized in time to account for changes in heart rate. Twenty-three well-known morphological parameters were extracted from each pulse during the in-lab, real-world wakefulness, and real-world sleep conditions. Statistical tests were conducted to assess possible differences in these three conditions (ANOVA) and by stratifying for low/high BP (t-test). **Results:** Most (22/23) PPG morphological parameters significantly differed between in-lab, real-world wakefulness and real-world sleep. More parameters (10 vs. 6) significantly differed between subjects with low and high BP during the real-world wakefulness than during in-lab conditions .**Conclusion:** This preliminary study underlines the ability of real-world PPG measurements to discriminate between subjects with low and high BP, setting the stage for future advancements in cuffless blood pressure monitoring.

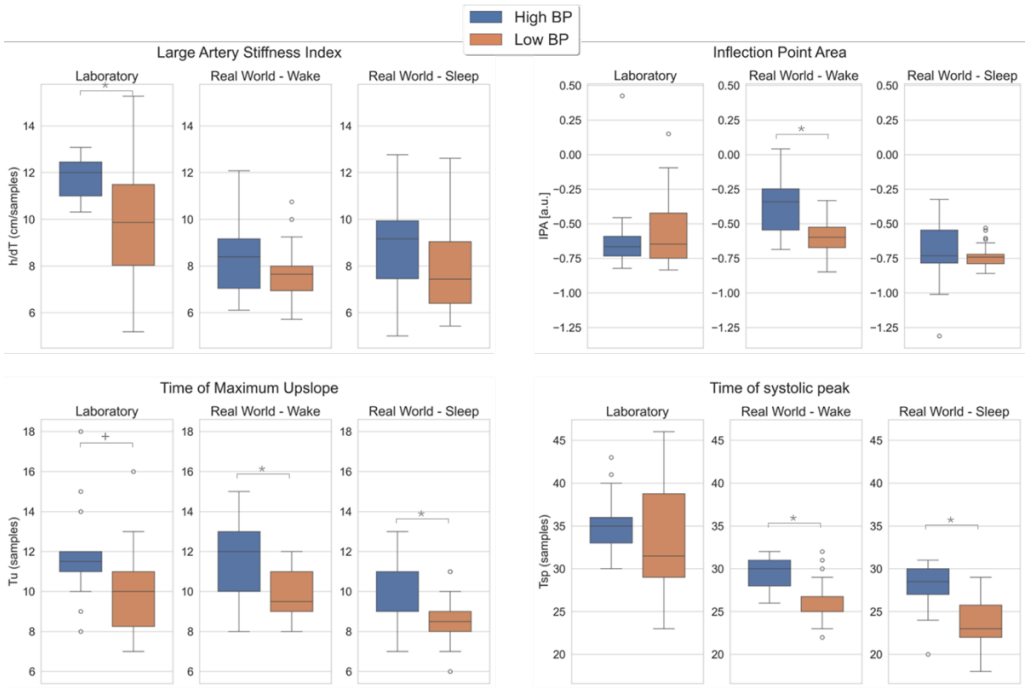

Figure 1. Distribution of 4 features during lab recording and real-world wake and sleep, stratified according to BP. Large artery stiffness index (top left) and inflection point area (top right) have been related to blood pressure. Elementary PPG features, such as the time of maximum upslope (bottom left) and the time of systolic peaks (bottom right), statistically differed amongst low and high BP subjects in real-world. Values represent median features across subjects. Time-domain features are expressed in samples due to the time-normalization.