

Low-Exertion Testing of Autonomic Cardiovascular Integrity Through PPG Signal Analysis

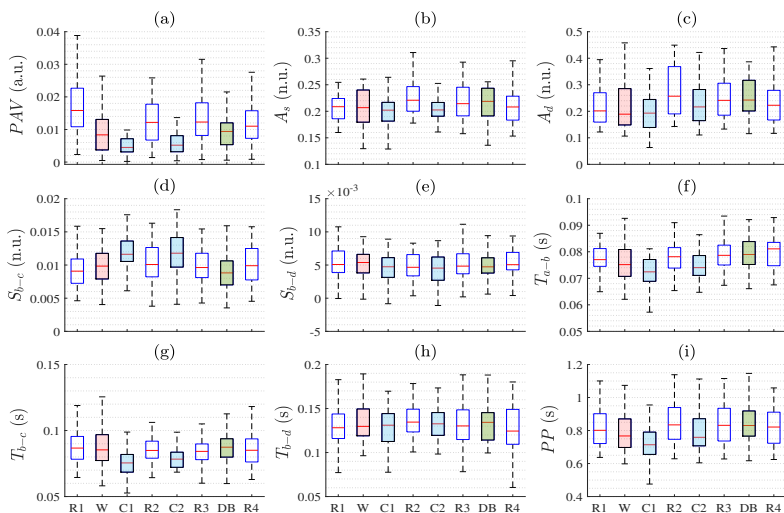
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Activity of the autonomic nervous system (ANS) is closely related to the cardiovascular system (CVS). Thus, any disturbance of the ANS may have a negative impact on CVS function. This study investigates the feasibility to assess autonomic cardiovascular integrity by using photoplethysmogram (PPG) signals.

PPG signals from 51 subjects were recorded. Two complementary tests (cold pressor and slow deep breathing) were used as stress and relaxation stimuli. Nine features of PPG pulse wave were extracted.

The results showed that the most sensitive feature to the sequence of complementary stimuli for autonomic cardiovascular integrity testing is the pulse amplitude variability – values of effect size to two cold pressor and one slow deep breathing stimuli were 1.444, 1.129, and 1.030, respectively. The obtained results may have significance in developing testing methodologies of assessing ANS for physically weak persons.



The boxplots of pulse wave features of PPG: (a) pulse amplitude variability PAV , (b) systolic area A_s , (c) diastolic area A_d , (d) slope coefficient S_{b-c} , (e) slope coefficient S_{b-d} , (f) time interval T_{a-b} , (g) time interval T_{b-c} , (h) time interval T_{b-d} , (i) pulse-to-pulse interval PP . Stages of the study protocol - $R1$, $R2$, $R3$, and $R4$ - Rest stages, $C1$ and $C2$ - Cold Water stages, corresponding to the cold pressor test, W - Warm Water stage, and DB - Deep Breathing stage, corresponding to the slow deep breathing test.