

Cardiovascular Effects of Mental Stress in Healthy Volunteers

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Introduction: Mental stress activates the human autonomic nervous system, which in turn leads to a physiological response of the cardiovascular system. While heart rate variability is often calculated to identify cognitive strain, in this work we investigate the effect of mental stress based on other vital parameters of the cardiovascular system.

Methods: A study with five rest phases and the Mannheim Multicomponent Stress Test was performed. Among others, we recorded electrocardiograms, impedancecardiograms, and continuous blood pressure with a CNSystems Task Force Monitor. This allowed us to deduce 18 vital parameters such as heart rate, pulse pressure, and cardiac output for every heartbeat. In addition, participants provided saliva samples and self-assessment questionnaires after each phase. Data from 44 healthy participants was used for statistical analysis in search for the vital parameters that exhibited the clearest response to the stress test. At first, the Friedman test identified whether a vital parameter (average of 5 min of each phase) showed an effect. Only those vital parameters that showed an effect were investigated with pairwise Wilcoxon ranksum tests to check between which phases effects occurred. If a vital parameter differed significantly between the stress test and all 5 rest phases, the effect size (rank-biserial correlation) of the parameter was computed.

Results: Fig. 1 presents results from the self-reports. From the 18 vital parameters derived, cardiac output, cardiac index, heart rate, mean blood pressure, and left ventricular work index showed significant differences ($p < 0.001$) between the stress phase and all five rest phases. They reached effect sizes of 0.28, 0.30, 0.31, 0.38, and 0.46 respectively, which are considered medium (0.3) to large (0.5) for rank-biserial correlation.

Conclusion: Of all vital parameters derived, we identified those who significantly differed between rest and stress states. The strongest effect was found for the left ventricular work index.

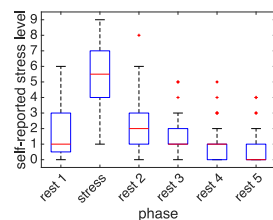


Fig. 1: Self-reported stress levels on a 10-step Likert scale.