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Ballistocardiography in Physical Training - Preliminary Study

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Abstract. Ballistocardiography (BCG) is a non-invasive method for measuring the amount of blood passing through the heart in a specified time by recording the recoil forces and movements of the body that result from contraction of the heart muscle in ejecting blood from the ventricles. It has been demonstrated earlier that the amplitude of the recoil forces increases after physical training. The goal of this preliminary study was to evaluate the potential of ballistocardiography as a method to monitor the effect of physical training on the physical condition of healthy volunteers. A special chair has been designed for ballistocardiographic studies. Under the chair there was four load cells to detect the weight of the chair and the person under the study. The recoil forces directed towards the head of the person were registered as changes of the detected weight. The chair was designed so that the position of the person is as reproducible as feasible. The signals from load cells were registered with dedicated hardware and analysed using LabView and Matlab software tools. Total of 43 healthy volunteers participated in the study. Their physical condition was evaluated using stress test based on FitWare Professional software manufactured by FitWare Oy, Mikkeli, Finland. Also the volumes of heart muscle and functional parameters of 34 persons were evaluated using MRI. These tests were performed before and after 10 weeks training period. In evaluation of the observed BCG signals before and after training period a change in the frequency spectrum was noticed in persons with a marked increase in maximal oxygen uptake rate (VO₂max). Corresponding increase in high frequency components of BCG signals was not noted with persons with minor or nonexistent increase in VO₂max. MRI studies didn't demonstrate any changes in the volume or functional parameters of cardiac muscle. This preliminary study indicates that it may be possible to evaluate the changes of physical condition due to physical training. Further studies are needed to evaluate the potential of BCG to quantitate the changes or even the level of physical performance of a person.

