

A STUDY OF HEART RATE VARIABILITY MEASUREMENT AND ANALYSIS METHOD UNDER WEAK LOAD TO UNDERSTAND AUTONOMIC ACTIVITY

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ABSTRACT

Cardiac disease is the second leading cause of death in Japan, and ischemic heart disease is the most common cause of death. Ischemic heart disease is the leading cause of death in the world, accounting for approximately 16% of all deaths worldwide. This ischemic heart disease is mainly caused by lifestyle-related diseases, excessive stress, and hypertension, and it has been shown that autonomic nervous system activity is related to this disease as a contributing factor. However, autonomic nervous system activity has not yet been rigorously indexed, and there is a need to index autonomic nervous system activity. Therefore, I used heart rate variability, one of the indicators of autonomic nervous system activity, to conduct an exercise load test at a minute load amount applicable to the elderly and weakly exercising people and extracted autonomic nervous system activity indicators by acquiring biological information from heart rate variability. We used the fact that exercise under a weak load causes parasympathetic retraction and sympathetic enhancement, as well as heart rate variability, to index autonomic nervous system activity. In addition, among several exercise load tests, the bicycle ergometer load test in the supine posture was employed to conduct this study. Noise seen at 0.167 Hz was cut by frequency transformation using a notch filter that removes specific frequency regions to remove respiratory components, and an additive averaging method was used to remove noise from cardiac fibrillation and body motion. In this study, heart rate was obtained as a time series, and parameters were extracted and evaluated for validity by regression analysis using a first-order delay and second-order delay system functions that can represent metabolic systems. Data analysis was performed on the measurements of men and women, and the results were compared. In this study, the subjects were men and women in their 20s, and measurements were taken at a pre-specified load amount, with instructions also given as to when to start pedaling the bicycle. The experimental results showed that each subject's heart rate regressed during the test to evaluate the appropriate load, indicating that the indexing of autonomic nervous system activity was successful. However, since the values obtained in this study were only in the 20s, it was not possible to confirm significant changes. In addition, several data were observed in which the participants became accustomed to the 30 seconds at rest and their heart rate increased before exercise as a preparation. Therefore, in future experiments, we will compare the waveforms obtained in this study with those obtained when the subjects themselves set the timing for pedaling the bicycle ergometer. We will also confirm the reproducibility of the results. It is necessary to increase the number of subjects, and to verify whether it is possible to extract autonomic indices from the elderly, who are the ultimate objective of this study, as well as subjects in their 30s and 40s, who are prone to accumulate stress, and whether there is an appropriate amount of load for any age group of subjects.