

Effect of Noise at Different Frequencies on Heart Rate Variability - Experimental Study Protocol

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Abstract : Low-frequency noise (LFN) has been recognized as a special environmental pollutant. It is usually considered a broadband noise with the dominant content of low frequencies from 10 Hz to 250 Hz. A growing body of data shows that LFN differs in nature from other environmental noises, which are at comparable levels but not dominated by low-frequency components. The primary and most frequent adverse effect of LFN exposure is annoyance. Moreover, some recent investigations showed that LFN at relatively low A-weighted sound pressure levels (40–45 dB) occurring in office-like areas could adversely affect the mental performance, especially of high-sensitive subjects. It is well documented that high-frequency noise disturbs various types of human functions; however, there is very little data on the impact of LFN on well-being and health, including the cardiovascular system. Heart rate variability (HRV) is a sensitive marker of autonomic regulation of the circulatory system. Walker and co-workers found that LFN has a significantly more negative impact on cardiovascular response than exposure to high-frequency noise and that changes in HRV parameters resulting from LFN exposure tend to persist over time. The negative reactions of the cardiovascular system in response to LFN generated by wind turbines (20-200 Hz) were confirmed by Chiu. The scientific aim of the study is to assess the relationship between the spectral-temporal characteristics of LFN and the activity of the autonomic nervous system, considering the subjective assessment of annoyance, sensitivity to this type of noise, and cognitive and general health status. The study will be conducted in 20 male students in a special, acoustically prepared, constantly supervised room. Each person will be tested 4 times (4 sessions), under conditions of non-exposure (sham) and exposure to noise of wind turbines recorded at a distance of 250 meters from the turbine with different frequencies and frequency ranges: acoustic band 20 Hz-20 kHz, infrasound band 5-20 Hz, acoustic band + infrasound band. The order of sessions of the experiment will be randomly selected. Each session will last 1 h. There will be a 2-3 days break between sessions to exclude the possibility of the earlier session influencing the results of the next one. Before the first exposure, a questionnaire will be conducted on noise sensitivity, general health status using the GHQ questionnaire, hearing organ status and sociodemographic data. Before each of the 4 exposures, subjects will complete a brief questionnaire on their mood and sleep quality the night before the test. After the test, the subjects will be asked about any discomfort and subjective symptoms during the exposure. Before the test begins, Holter ECG monitoring equipment will be installed. HRV will be analyzed from the ECG recordings, including time and frequency domain parameters. The tests will always be performed in the morning (9-12) to avoid the influence of diurnal rhythm on HRV results. Students will perform psychological tests 15 minutes before the end of the test (Vienna Test System).

Keywords : neurovegetative control, heart rate variability (HRV), cognitive processes, low frequency noise

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