News Release

Title

Vascular endothelium as a target tissue for short-term exposure to low-frequency noise that increases cutaneous blood flow

Key Points

1. A novel effect of low frequency noise (LFN) on microcirculation was determined

2. Broad-band LFN (bLFN) exposure increased cutaneous blood flow (cBF) in humans

3. Exposure to pure-tone components in bLFN further increased cBF in humans and mice

4. The endothelium was identified as a target tissue for short-term exposure to LFN

5. Nitric oxide contributed to the increased level of cBF caused by LFN exposure

Summary

Harmful health effects of exposure to low-frequency noise (LFN) defined as noise with frequencies at ≤100 Hz on the circulatory system have been a concern. However, there has been no study on the effects of exposure to LFN on the circulatory system with consideration of its frequencies and decibels. In this study, the effects of short-term exposure to broad-band LFNs and their pure-tone components (pure-tone LFNs) on cutaneous blood flow in the extremities including the hands were investigated. In our fieldwork study, we first sampled some kinds of common broad-band LFNs. Our human study then showed that broad-band LFN with a narrower frequency range more strongly increased cutaneous blood flow than did broad-band LFN with a wider frequency range. Pure-tone LFNs of 70-100 Hz at ≤85 dB(Z), but not pure-tone LFNs exceeding 100 Hz, further increased levels of cutaneous blood flow. Our wavelet-transform spectrum analysis of cutaneous blood flow next revealed that the nitric oxide (NO)-dependent and -independent vascular activities of the vascular endothelium were specifically increased by exposure to pure-tone LFN. Our animal study again indicated that exposure to pure-tone LFN increased cutaneous blood flow in mice with impairments of bilateral inner ears as well as cutaneous blood flow in control mice, suggesting a limited effect of inner ear function on the LFN-mediated increase in cutaneous blood flow. The NO-dependent suppressive effect of pure-tone LFN on cutaneous blood flow was confirmed by inhibition of vascular endothelial activity through intravenous injection of an NO inhibitor in wild-type mice. Taken together, the results of this study demonstrated that the vascular endothelium is a target tissue of LFN and that NO is an effector of the LFN-mediated increase in cutaneous blood flow. Since improvement of peripheral circulation could generally promote human health, short-term exposure to LFN may be beneficial for health.

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