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Low-frequency noise: Experiences from individuals reporting LFN complaints

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ABSTRACT

Until now, Low-frequency noise (LFN) is hardly recognized as an environmental stressor, and its consequences on daily functioning have been rarely investigated. LFN is predominantly produced by human-made sources, and due to the increasing industrialization, these sources and accordingly the number of LFN complaints is steadily rising. Although the majority of the general population does not consciously perceive LFN, an estimated 2% of the Dutch adult population experiences severe annoyance from its exposure. Individuals sensitive to perceiving LFN in their everyday life report various physical complaints and particularly psychological complaints, such as sleeping difficulties, fatigue and stress, and cognitive difficulties such as difficulties in concentration or so-called executive functions. Yet, it is unclear why some people are more sensitive to and suffer more from LFN than others, and a comprehensive (neuro)psychological investigation in this population is still lacking. During an exploratory study, the demographic and personal characteristics of LFN-sensitive individuals, the perceptions of LFN-sensitive individuals and the reported physical, psychological, and social health-related symptoms and restrictions in daily living were investigated.

Noise exposure presents one of the most serious environmental stressors that can substantially affect the health, daily living, and quality of life of affected individuals [1, 2]. The World Health Organization (WHO) specifically emphasizes the increased risk for cardiovascular disease, sleep disturbances, annoyance, and cognitive impairments as consequences of noise exposure [3]. While a lot of attention is paid to noise and its adverse impact on health and well-being, a special type of noise, so-called, low-frequency noise (LFN), is still rarely investigated as an environmental stressor. Low-frequency noise refers to noise around and below the human hearing threshold (125Hz) [4]. Since LFN is mainly produced by human-made sources, such as traffic or ventilation systems, the growing industrialization seems to be also accompanied by rising numbers of LFN complaints [4, 5]. For example, health authorities received more LFN reports since 2016 than reports of normal noise as

stated by the Dutch Institute for Public Health and the Environment [4]. However, the majority of the general population does not consciously perceive LFN and it is presently unknown what proportion is especially sensitive to perceiving LFN or why some individuals are more sensitive. One estimation by the RIVM suggests that 8% of the Dutch adult population experiences some and 2% severe annoyance from LFN exposure [6]. Moreover, there is still much unknown regarding the sources of the perceived sound and the causes or mechanisms underlying the reported complaints.

Among those reporting to perceive LFN in their everyday life, various physical, psychological, cognitive, and daily functioning restrictions are reported [5, 7, 8, 9]. Specifically, reported physical symptoms include headaches or dizziness and main psychological complaints include annoyance, sleeping difficulties, fatigue, stress, or feelings of depression. Furthermore, cognitive difficulties in concentration, in so-called executive functions, or while performing cognitively demanding tasks are reported. However, evidence from research examining the effect of LFN on objective cognitive test performance shows mixed results and does not allow a consensus so far [10]. Overall, these reported complaints are assumed to significantly affect individuals' daily functioning and may lead to relationship or family problems, housing issues, incapacity for work, or job loss [5, 9, 11]. Considering the substantial subjective burden experienced by individuals reporting to perceive LFN, there is a high need for a thorough and systematic (neuro)psychological investigation of the consequences of LFN.

Moreover, in order to understand the individuals suffering from LFN and their complaints, additional factors have to be taken into account. For instance, individual differences in the sensitivity to specific frequencies and hearing thresholds might underlie the conscious perception of LFN [9]. Within the frame of general noise, it was suggested that such noise sensitivity and also other non-acoustic factors including sociodemographic and individual characteristics or personality constitute substantial predictors for reactions to noise and psychological health outcomes [12, 13, 14, 15, 16]. However, research on such factors and the differential characteristics of individuals suffering from LFN specifically is still scarce [8]. In regard to sociodemographic factors, it seems that LFN-perceptions are most frequently reported by individuals aged between 50 and 70 years and in two-thirds of the cases by females [5, 9, 17, 18]. Furthermore, first evidence considering the association between personality and LFN-perception seems to point towards introverts being more sensitive to LFN [19, 20], however firm conclusions regarding this or other aspects of personality cannot be made so far.

Finally, survey studies investigating the location, time, and type of LFN-perceptions suggest substantial heterogeneity requiring further investigation. Where, when, and how LFN is perceived seems to differ greatly between individuals. There seem to be general tendencies in reports of LFN being perceived mainly indoors, especially at home, and mostly all the time or at nights only, rarely at daytime alone [5, 9, 11, 18]. Individuals seem to predominantly perceive LFN by hearing (often described as a humming, but sometimes also as buzzing, throbbing, or engine-like sound). However, also feelings of pressure and vibrations are reported [5, 9, 11, 18]. The considerable individual differences in the LFN-perceptions necessitate further investigation and the examination of possible subgroups is recommended.

Overall, considering the possible adverse health effects of LFN and the experienced burden of affected individuals, more attention should be given to LFN as an environmental stressor, as was also indicated by the WHO [1]. Thorough and systematic research on individuals reporting to experience LFN in their daily life and their complaints is still scarce. Current insights are partly based on studies applying short-term exposure of LFN in laboratory settings, small groups, restricted test batteries, specific settings (e.g. occupational settings), different definitions of LFN, or individuals who are not always sensitive to LFN. Therefore, a current research project by the Department of Clinical and Developmental Neuropsychology at the University of Groningen investigates the demographic and personal characteristics of individuals reporting LFN complaints, their specific LFN-perceptions as well as the reported physical, psychological, and social health-related symptoms and restrictions in daily living compared to individuals who are not perceiving LFN.

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