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**Institutionen för Fysiologi och Farmakologi**

# Associations between stress and hearing problems - epidemiological and experimental findings

**AKADEMISK AVHANDLING**

som för avläggande av medicine doktorsexamen vid Karolinska Institutet offentligen försvaras i Atrium, Nobels väg 12, Solna.

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av

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## ABSTRACT

It is well established that long-term stress without sufficient recovery can induce plastic changes in certain brain regions by suppressing neural growth or by retraction of dendrites. Many of these effects can be due to a dysregulation of the hypothalamic-pituitary-adrenal (HPA)-axis, which is the principal system controlling systemic stress response. While being a well known risk factor for several psychological disorders, e.g. depression, schizophrenia, and bipolar disease, little is known about the effects of long-term stress in relation to the auditory system. Therefore, the aim of this study was to explore the relationship between long-term stress and hearing problems. The specific aims of the study were to i) determine whether there is a relationship between hearing problems and different measures of health and work related stressors in the Swedish working population, ii) to determine whether the ability to hear speech in noise varies with emotional exhaustion (EE), before and after an acute stress task, iii) to validate a hyperacusis questionnaire (HQ) in different strata of EE, and iv) to validate a personal heart rate monitor (Polar RS800) against a traditional ECG-method for assessment of heart rate variability. Two different research approaches were used: a) an epidemiological questionnaire-based study involving 9,756 working Swedes, and b) an experimental study involving 348 individuals aged 23 to 71 years, with low, intermediate or high levels of EE. In the epidemiological study, stress and hearing problems were assessed with self-rating scales for hearing complaints, tinnitus and EE. In the experimental study, hearing in noise (HINT) and uncomfortable loudness levels (ULLs) were assessed before and after an acute stress task. Pure tone audiometry, tinnitus, heart rate variability (HRV) and EE were assessed at baseline only. The results of the epidemiological study demonstrated a statistically significant higher prevalence of hearing problems in individuals exposed to work-related stressors or threats, such as occupational stress, poorer self-rated health, long-term illness, poorer sleep quality, higher burnout scores, more symptoms of long-lasting stress, and higher performance-based self-esteem. The results revealed new risk factors for the auditory system that have not been described previously. The results from the experimental study demonstrated that, when adjusting for age and hearing loss, higher levels of EE were associated with a poorer ability to hear speech in noise in both men and women. The validation study of the HQ demonstrated significant correlations between the HQ and ULLs on both ears in those with intermediate and high EE but not in individuals with low EE. All correlations were negative, indicating that higher HQ-scores are correlated with lower ULLs. Taken together this thesis presents new evidence for associations between long-term stress and different types of hearing problems. In particular the results suggest that the potential role of long-term stress as an underlying factor in auditory pathology should be considered in clinical settings.