



# Association of Sleep Characteristics with Tinnitus and Hearing Loss



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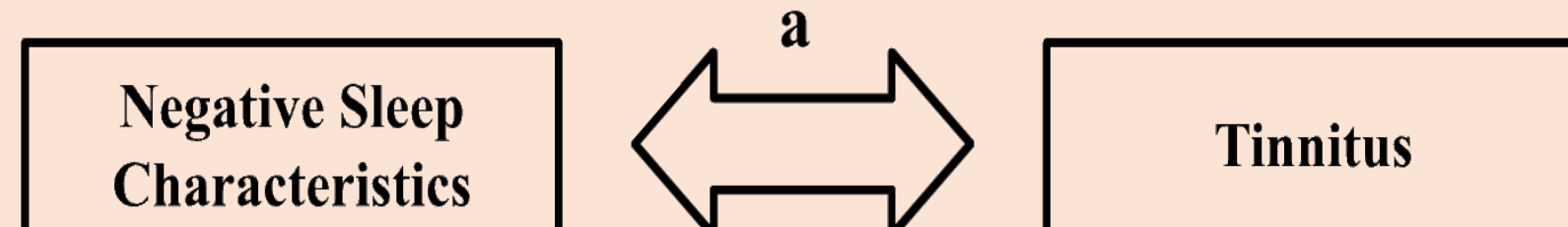
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## Abstract



**50-70 million**

U.S. adults report **tinnitus and sleep disorders**, with a significant overlap.

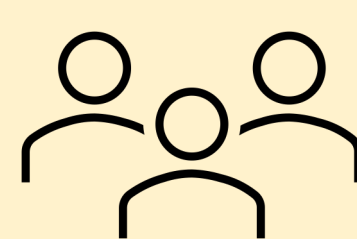


Recent studies have shown an association between sleep disorders and hearing loss

Does hearing loss play a role in the association between tinnitus and sleep disorders?



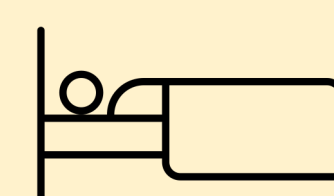
National Health and Nutrition Examination Survey (2005-2018)



9,693 adults (≥ 20 years of age)

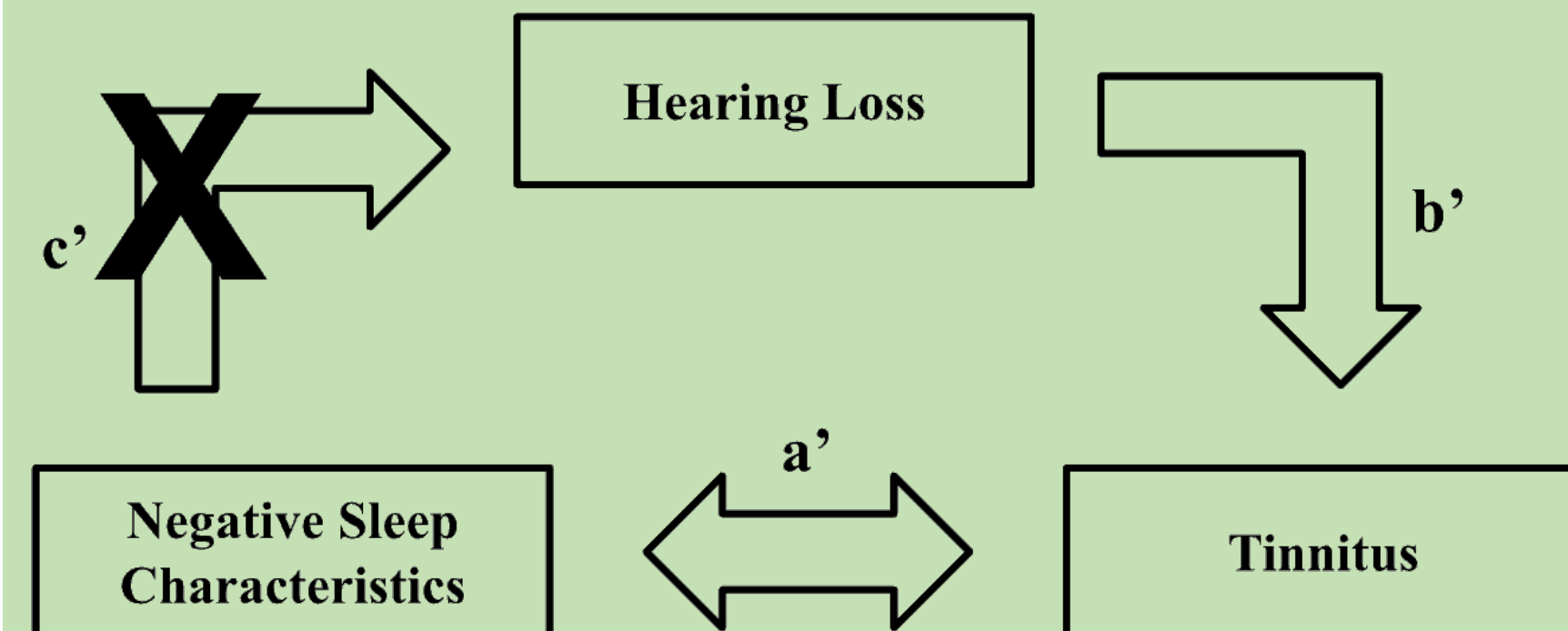
### Measures

Negative sleep characteristics (less hours of sleep, trouble sleeping, OSA symptoms, history of sleep disorders)



Audiometry-measured hearing loss

Bothersome Tinnitus



There was an association between **negative sleep characteristics and tinnitus** but there were **NO** significant associations between sleep and **hearing loss**, suggestive of a mediating role within the association between **negative sleep characteristics and tinnitus**.

## Introduction

Disrupted sleep is a well-established risk factor for worsening the distress caused by tinnitus. Conversely, tinnitus itself is a risk factor for poor sleep quality, creating a vicious cycle.

Various mechanisms have been proposed to explain these links, mainly via central auditory pathway such as hyperarousal of the sympathetic nervous system in limbic and autonomic brain activities exacerbating the intolerance of tinnitus.

Recently, there has been emerging evidence indicating the association between sleep disorders and hearing loss.

In this study, we **examined the association between sleep characteristics, tinnitus, and hearing loss** based on a large population-based cohort of US adults. We explored the role of hearing loss as a potential mediator of associations between negative sleep characteristics and tinnitus.

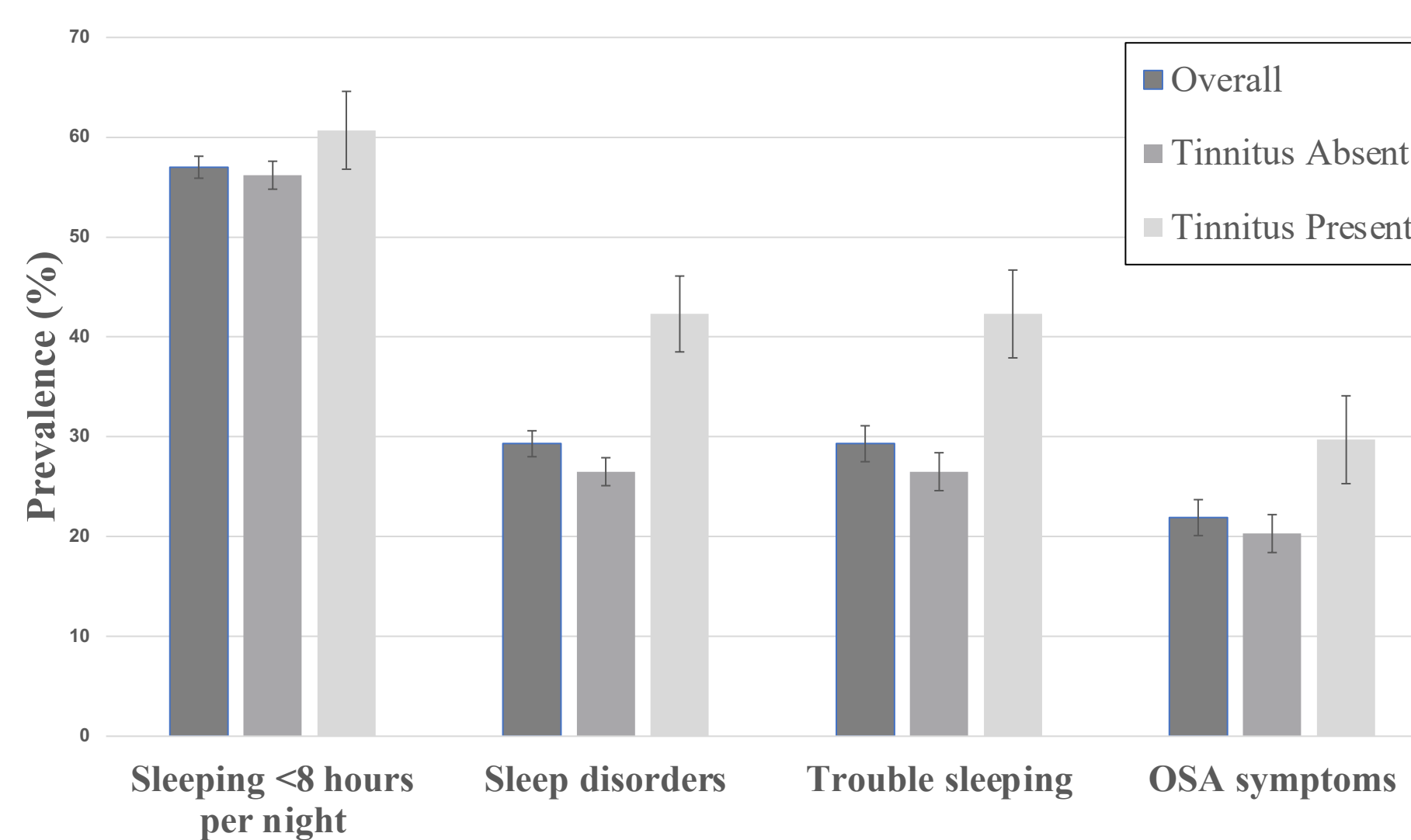
## Methods and Materials

- **Study population:** 9,693 adults (≥20 years) from NHANES 2005-2018 who completed audiometric testing and questionnaires on tinnitus and sleep characteristics.
- **Sleep Characteristics:** classified based on questions that asked about number of sleep hours, diagnosis of a sleep disorder, trouble sleeping, or a history of snoring, stopping breathing, and daytime sleepiness (OSA symptoms).
- **Hearing loss:** Speech-frequency pure-tone average (PTA) was calculated for each ear based on thresholds at 0.5, 1, 2, and 4kHz. Audiometry-measured hearing loss was defined as speech-frequency PTA at 25 dB HL or greater in better hearing ear.
- **Tinnitus:** Report of bothersome tinnitus in the past 12 months.
- **Statistical analysis:** Univariable and Multivariable regression analyses were performed to quantify associations between sleep characteristics, tinnitus, and hearing loss.

## Results

**Results #1.** The prevalence of **sleep disorders, trouble sleeping, and OSA symptoms** were **higher** in adults with **bothersome tinnitus**.

**Figure 1:** Prevalence of negative sleep characteristics for the overall cohort and presence of bothersome tinnitus in the past 12 months



**Result #2.** Negative sleep characteristics (less hours of sleep, diagnosis of a sleep disorder, trouble sleeping or OSA symptoms) were **NOT** associated with audiometry-measured hearing loss in multivariable models adjusted for demographics and comorbidities but were significantly associated with bothersome tinnitus.

This association remained **significant without substantial attenuation** in multivariable models additionally adjusting for hearing levels: sleeping <8 hours/day (vs. ≥8) (OR:1.28 [95%CI:1.08-1.52]), trouble sleeping (OR:1.78 [95%CI:1.45-2.19]), being diagnosed with sleep disorders (OR:1.57 [95%CI:1.14-2.15]), and report of OSA symptoms (OR:1.42 [95%CI: 1.08-1.88]).

## Discussion

- Our findings suggest no significant role of hearing loss as a mediator contributing to the association between negative sleep characteristics and bothersome tinnitus on a population-level.
- Given this study's cross-sectional design, the causality of the relationship cannot be established. Self-reported data is subject to bias such as individuals overestimating sleep duration. Presence of OSA symptoms was defined by questionnaire data, not formal PSG.
- Nevertheless, these results signify an association between poor sleep and tinnitus without any significant association between poor sleep and hearing loss.

## Conclusions

In this nationally representative sample of US adults ≥20 years old, negative sleep characteristics were associated with tinnitus while there was no clinically meaningful association between sleep and hearing loss.

Our findings suggest that the relationship between poor sleep and tinnitus is likely contributed by central processes without a major role of mediation via the peripheral auditory system.

### References

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