

Associations Between Residential Indoor Temperatures and Self-Reported Sleep Problems in UK adults: a cross-sectional study

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Background. Sleep is a key physiological state and a complex behaviour that is fundamental to an individual's physical and mental health and survival. In addition, poor sleep characteristics, sleep symptoms and sleep disorders are common and take a significant toll on public health. Sleep is influenced by the complex and dynamic interrelationships between individuals and their physical and social environments throughout their lifetimes. The thermal environment is an important but relatively neglected factor affecting human sleep in ways which may be mediated by adaptive behaviours and/or design features of the built environment. Both excessively high and low indoor temperatures can disrupt sleep even in healthy individuals who do not suffer from sleep disorders. Limited observational studies currently exist on the impact of indoor temperatures on sleep within housing under real-life situations.

Aims. This study aims to understand the extent to which adult sleep is influenced by residential indoor temperatures in a real-life UK context, by investigating the relationship between room temperatures and self-reported sleep problems, using data from the NSHD (National Survey of Health and Development), a birth cohort which started in 1946 across England, Wales and Scotland.

Methods. A cross sectional analysis is conducted with 1989 NSHD data, which was collected across 2 calendar years (1989-1990). Logistic regression models are used to test associations between room temperature as the main exposure (continuous variable) and two sleep questions as main outcomes (categorical variable). Room temperatures were objectively recorded once per participant by thermometers during nurse visits. The two sleep problems are: 'How often have you had trouble in getting off to sleep over the last year?' and 'Have you had trouble with waking up and not being able to get back to sleep over the last year?'. They reflected different aspects of sleep quality disturbances: difficulty in falling asleep and difficulty in maintaining sleep. The answer is divided into 6 categories according to the frequency of sleep problems: never/occasionally/sometimes/quite often/very often/always. These categories are turned into binary in the analysis. Relevant covariates are controlled including: demographics (gender/social class), health-related (BMI/exercise/physical efforts from work/alcohol consumption/smoking status), housing variables (heating types/number of bedrooms), and year and time of a day (temperature recording). To adjust for seasonal effects, month of temperature recording is attributed to one of four seasons (Spring: March-May, Summer: June-August, Autumn: September-November, Winter: December-February), according to the seasonal classification from Met Office (1). Logistic regression analysis is used to test the potential impact of adjusting these variables on the association between room temperature and self-reported sleep problems.

Results. 2475 participants are drawn from the NSHD study, 1158 (46.8%) female, 1317 (53.2%) male. Participants were all 43 years old during the data collection. After removing outliers, room temperature ranged from 15°C-30°C, with a mean of 21.77°C (SD: 2.81).

Surprisingly, more than 60% of participants reported that they never had sleep problems in the past year (sleep problem 1: 70.2%; sleep problem 2: 62.9%). 13.5% of households had room temperatures lower than the WHO guidelines for healthy housing recommended minimum of 18°C (2). 10.2% of households had temperature higher than 26°C, which is the overheating criteria for bedrooms according to CIBSE TM59 (3).

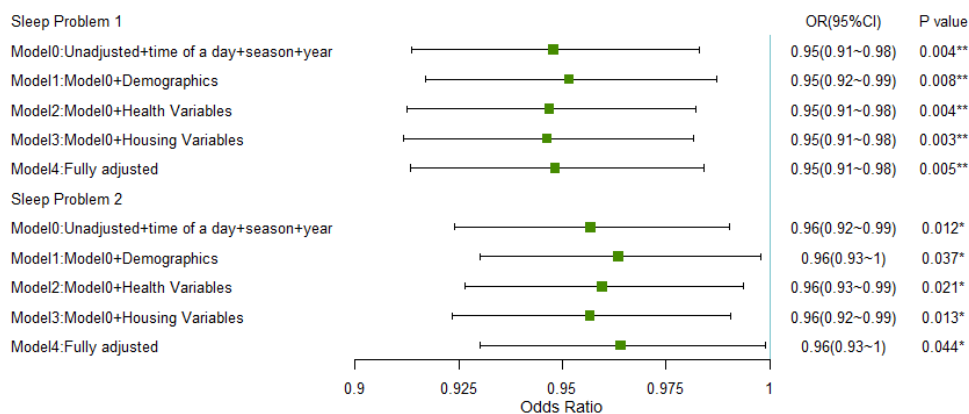
As shown in Figure 1, room temperature was significantly associated with self-reported sleep problems across all models. The associations in these models were fairly robust with little variations in effect size (OR: odds ratio). ORs less than 1 indicated that a positive effect of lower odds of having sleep problems in relation to a unit increase in residential indoor temperature. ORs of the baseline models for two sleep problems are 0.962 (95%CI: 0.932-0.992; P: 0.014) and 0.955 (95%CI: 0.927-0.983; P: 0.002) respectively. As for fully adjusted models, OR is 0.948 (95%CI: 0.913-0.984; P: 0.005) in sleep problem 1 and 0.964 (95%CI: 0.93-0.999; P: 0.044) in sleep problem 2.

Conclusions. There are significant associations between residential indoor temperature and two self-reported sleep problems in UK adults aged 43 years from the NSHD study. Results indicate that, within the range of room temperature in this sample [15°C-30°C; mean: 21.77°C; SD: 2.81], each degree increase in room temperature was associated with lower odds of reporting two sleep problems. Further research is needed on the impact of exposures to a wider range of indoor temperature (e.g. heatwaves), as well as the potential role of behavioural adaptations and outdoor temperatures. Other sleep measures such as sleep duration and latency should be considered for a more holistic assessment of sleep health.

Keywords. Indoor temperature, sleep problems, self-report, residential, NSHD

Figure 1

Logistic regression models comparison of room temperature and two sleep problems



References

1. Met Office. (n.d.). Seasons. Retrieved January 13, 2023, from <https://www.metoffice.gov.uk/weather/learn-about/weather/seasons>.
2. World Health Organization. (2018). WHO Housing and Health Guidelines. Retrieved from <https://www.ncbi.nlm.nih.gov/libproxy.ucl.ac.uk/books/NBK535298/>
3. CIBSE. (2017, May). TM59 design methodology for the assessment of overheating risk in homes. Retrieved from <https://www.cibse.org/knowledge-research/knowledge-portal/technical-memorandum-59-design-methodology-for-the-assessment-of-overheating-risk-in-homes>.