14th ICBEN 2023 18 - 22 JUNE BELGRADE

14th ICBEN Congress on Noise as a Public Health Problem

Associations of bedroom noise, $PM_{2.5}$, CO_2, temperature and humidity with actigraphically assessed sleep

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ABSTRACT

The bedroom environment plays a key role for high-quality sleep. Studies objectively assessing multiple descriptors of the bedroom environment as well as sleep are scarce. In this study, we measured fine particulate matter ($PM_{2.5}$), temperature, humidity, CO_2, barometric pressure and noise levels continuously for 14 consecutive days, in the bedroom of 62 participants (62.9% female, mean±SD age 47.7±13.2 years), who wore a wrist actigraph and completed daily morning surveys and sleep logs. In a hierarchical mixed effect model that included all environmental variables and adjusted for elapsed sleep time and multiple demographic and behavioral variables, sleep efficiency calculated for consecutive one-hour periods decreased in a dose-dependent manner with increasing levels of $PM_{2.5}$, temperature, CO_2 and noise. Sleep efficiency in the highest exposure quintiles was 3.2% ($PM_{2.5}$, $p<0.05$); 3.4% (temperature; $p<0.05$), 4.0% (CO_2, $p<0.01$) and 4.7% (noise, $p<0.0001$) lower compared to the lowest exposure quintiles (all p-values adjusted for multiple testing). Barometric pressure and humidity were not associated with sleep efficiency. Bedroom humidity was associated with subjectively assessed sleepiness and poor sleep quality (both $p<0.05$), but otherwise environmental variables were not statistically significantly associated with actigraphically assessed total sleep time and wake after sleep onset or with subjectively assessed sleep onset latency, sleep quality and sleepiness. Assessments of bedroom comfort suggest subjective habituation irrespective of exposure levels. These findings add to a growing body of evidence highlighting the importance of the bedroom environment – and especially noise levels – for high-quality sleep.

Keywords: sleep, air quality, noise, actigraphy, $PM_{2.5}$, CO_2

This research was recently published in the peer-reviewed literature. Thus, the reader is referred to the journal publication:

Basner, M., Smith, M.G., Jones, C.W., Ecker, A.J., Howard, K., Schneller, V., Cordoza, M., Kaizi-Lutu, M., Park-Chavar, S., Stahn, A.C., Dinges, D.F., Shou, H., Mitchell, J.A., Bhatnagar, A., Smith, T., Smith, A.E., Stopforth, C.K., Yeager, R., Keith, R.J.:

Associations of bedroom $PM_{2.5}$, CO_2, temperature, humidity, and noise with sleep: An observational actigraphy study.

Sleep Health, published online April 18, 2023, https://doi.org/10.1016/j.sleh.2023.02.010