# Exposure to fine aerosols in sleeping environments of Lisbon dwellings

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Since people spend a third of their lives sleeping and that sleep is essential to the well-being, performance and health of individuals, sleeping environments have started to gather the attention of the scientific community in recent years to assess exposure levels and how they may affect sleep quality - this is the question that remains unanswered until now. In addition, this micro-environment is poorly characterized (Canha et al., 2021), leading to inaccurate assessment of the integrated daily exposure of individuals. Most studies focus on comfort parameters (temperature and humidity) or single pollutants, such as carbon dioxide ($CO_2$). The characterization of indoor air quality during sleep faces several challenges that make it difficult to achieve (such as the noise interference of monitoring equipment in the sleep of individuals) and, therefore, it is essential to implement monitoring strategies that overcome them.

The HypnosAir research project (www.hypnosair.com) aims to address this challenge. Preliminary studies carried out by HypnosAir team in Lisbon found that 9 out of 10 bedrooms presented mean $PM_{2.5}$ levels during the sleeping period above the international guideline value of 5 $\mu g.m^{-3}$ recommended by the World Health Organisation (WHO, 2021). Overall, mean $PM_{2.5}$ levels of 15.3 ± 9.1 $\mu g.m^{-3}$ were found for 10 bedrooms in Lisbon (Canha et al., 2020). This preliminary study was carried out using real-time monitoring equipment, which does not allow to provide a chemical characterisation of $PM_{2.5}$ and, consequently, to perform source apportionment studies.

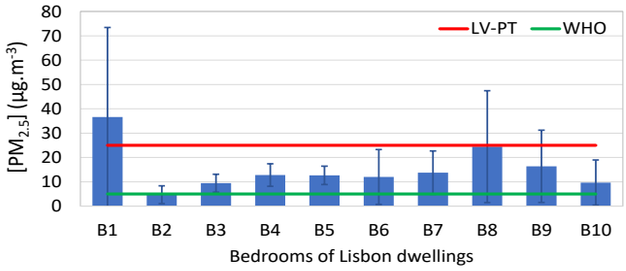


Figure 1. $PM_{2.5}$ levels during the sleep period in 10 bedrooms of Lisbon dwellings (Canha et al., 2020). The red line represents the limit value (LV) established by the Portuguese legislation (Portaria nr 138-G/2021, 2021) and the green line represents the guideline value recommended by WHO.

To provide a more complete characterisation of the exposure of individuals to fine aerosols during sleep, HypnosAir aims to sample $PM_{2.5}$ in 30 bedrooms of Lisbon metropolitan area (both indoors and outdoors) and, then, fully chemically characterise them to quantify the contribution of pollution sources.

To this end, in early 2023, the HypnosAir team started a sampling campaign in 30 dwellings during the sleeping period (weeknights only). For indoor sampling, silent $PM_{2.5}$ samplers (SILENT Sequential Air Sampler - FAI Instruments S.r.l., Italy) were used, while for parallel outdoor sampling, medium volume samplers (MVS6, Leckel, Sven Leckel, Germany) were used. In each environment, $PM_{2.5}$ was collected in two different filter matrices, namely, Teflon and quartz, for complementary chemical analyses. $PM_{2.5}$ levels will be assessed gravimetrically.

The present work will provide the first results of the $PM_{2.5}$ sampling, using the gravimetric method, which was carried out during the HypnosAir sampling campaign. Parallel outdoor levels will also be assessed.

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