

Measured and perceived indoor environment quality in remote work offices

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SUMMARY

In recent years, remote work has become a new common form of work. In this study, the indoor environment quality (IEQ) was assessed with measurements and questionnaires in 71 home offices. The measured parameters varied between home offices; temperature, relative humidity, carbon dioxide concentration, and total volatile organic compound (TVOC) concentration were 20.2–26.4 °C, 18–60%, 540–1297 ppm, and 35–1291 µg/m³, respectively. The workers rarely reported any complaints about environmental factors or job-related symptoms. Overall, the measured and perceived IEQ was quite good in remote work offices.

KEYWORDS

Indoor air quality, MM40 questionnaire, volatile organic compounds, home office

1 INTRODUCTION

Remote work has become more common recently, especially due to COVID-19 pandemic when millions of workers were forced to work from their homes. When in 2018 less than 5% of employees in the EU reported working remotely regularly, in spring 2020, the corresponding percentage was 48% (Eurofound 2020).

Indoor air quality in offices and its effects on health and productivity have been extensively studied (e.g., Fang et al. 2004; Mandin et al. 2017). Indoor air quality in homes has been studied, but not from the perspective of working conditions. It is known, that indoor environment conditions in homes differ from the conditions in office, e.g., generally greater number of volatile organic compounds (VOC) can be identified in home environments than in offices (Paciência et al. 2016). Home environments are affected by more potential VOC sources, and additionally, the ventilation in homes may not be as efficient as in the office (Paciência et al. 2016; Wallenius et al. 2021). In this study, we investigated the indoor environment quality (IEQ) in 71 knowledge workers' home offices in Eastern Finland and North Karelia regions with questionnaires and by measuring temperature, RH, CO₂ concentration, TVOC concentration, and air exchange rate.

2 METHODS

Indoor air temperature (°C), RH (%), and CO₂ concentration (ppm) were measured at home offices with a Testo 435 or TSI IAQ-Calc 7525 devices. VOC samples were collected from the immediate vicinity of the working desks at approx. 1.0–1.5 m height into Tenax TA - adsorbent tubes using SKC AirChek 3000 and 222 pumps. VOC samples were analysed according to the ISO 16000-6:2004 standard with a TD-GC-MS -system in SCAN-mode and TVOC was determined using toluene equivalents. Airflow rates (L/s) of the apartments were measured with Swema 3000 instrument connected to a SwemaFlow 125 airflow hood from terminal devices (supply and exhaust air).

Perceived IEQ was investigated using the Finnish Institute of Occupational Health's (FIOH) Indoor Air Questionnaire, described in more detail by Reijula and Sundman-Digert (2004). Background information on the apartment and remote working habits were gathered with an interview.

3 RESULTS AND DISCUSSION

The measured IEQ parameters varied considerably between home offices. The mean temperature in home offices was 23.3 °C (with a range 20.2–26.4 °C); RH 36% (18–60%); CO₂ concentration 832 ppm (540–1297 ppm); and TVOC concentration 199 µg/m³ (35–1291 µg/m³), respectively. The most prevailing VOCs were decamethyl cyclopentasiloxane and different terpenes, originating probably from personal care products and wooden materials. The air exchange rate was on average 0.32 l/s/m² measured from the exhaust air terminal devices (n=40).

According to the indoor air questionnaire, the most common complaints about environmental factors at home offices that had occurred every week were dim light or glare/reflections (8% of the respondents) and stuffy air (6%). In the present study, the participants reported less environmental problems or job-related symptoms at home offices than in a previous Reijula and Sundman-Digert (2004) study among office workers. In the present study, the participants rarely reported any job-related symptoms; 4% of the participants reported job-related fatigue, headache, or difficulties in concentrating. Other job-related symptoms were less common.

4 CONCLUSIONS

The IEQ varied between home offices and, as a consequence, people had diverse working conditions. Overall, in most of the cases, the measured values fulfilled the Finnish reference values for IEQ. The IEQ was also perceived as quite good.

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