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Relationships between mental health and indoor environmental quality (IEQ) in the home workplace

Bouke BOEGHEIM¹, Rianne APPEL-MEULENBROEK*¹, Dujuan YANG¹ and Marcel LOOMANS¹

¹ Eindhoven University of Technology, Eindhoven, the Netherlands

* Corresponding author: h.a.j.a.appel@tue.nl

SUMMARY

The understanding of mental health in the context of the physical workplace's indoor conditions has not yet received much attention, even less related to employees that are teleworking. Therefore, this study aimed to identify potential relationships between indoor environmental quality (IEQ) conditions and workplace mental health while working from home.

Data was collected through a cross-sectional survey; repeated momentary surveys; and IEQ sensors. Participants worked full-time from home during the measuring period. Datasets were analyzed using bivariate and path analyses.

The findings indicate that both subjective experience and objective IEQ conditions, as well as workplace suitability and distraction are related to workplace mental health.

This study is one of the first to explore workplace mental health in relation to simultaneously assessed (perceived and measured) multiple IEQ parameters in the home workplace. Working from home is expected to be more common in the post-Covid world. Therefore, additional research is required.

INTRODUCTION

The influence of the indoor environmental quality (IEQ; air quality, thermal comfort, lighting, and noise) on humans is evident and often associated with health outcomes (Hanc et al., 2019). While physical and social health in relation to the workplace are commonly studied, mental health in the context of the physical workplace remains underexposed (Hoisington et al., 2019; Mujan et al., 2019). It is difficult to quantify mental health due to its subjective nature. Previous studies demonstrated significant relations between IEQ conditions and their perception (Mujan et al., 2019), but are limited in identifying potential mental health consequences. Both objective and subjective IEQ should be reviewed, as they are not always aligned. In addition, in most research solely one IEQ construct is tested against one other variable and all others are assumed to be constant (Parkinson et al., 2019). By using a holistic approach including all four IEQ parameters, both direct and indirect effects can be reviewed.

Since the outbreak of the Covid-19 infection, the workplace at home has suddenly become more relevant than ever. However, research on teleworking

so far has neglected IEQ conditions at home. Research in the context of mental health while working from home is nearly non-existent. Therefore, this research aims to identify relationships between IEQ conditions and employee mental health while working at home.

CONCEPTUAL MODEL

Based on the examination of scientific literature a network of relevant variables was constructed, which functioned as a conceptual model (see Figure 1). Distinguished variable groups are personal characteristics; objective IEQ conditions; workplace at home aspects; subjective IEQ conditions; and employee mental health. This conceptual model has been the basis for the subsequent analyses.

METHOD

To collect data, 36 Dutch consultants participated in April 2020. These participants were recruited via an open request to engage in the study on the intranet of one consultancy firm. Due to governmental stay-at-home orders to prevent the spread of Covid-19, all participants worked full-time from home. Environmental satisfaction as well as mental health concepts were captured by short, two-daily point-in-time (PIT) surveys in a five-business day measuring period. At the end of the week a reflective extensive survey covered variables not being subject to changes during the day. Moreover, the actual IEQ conditions were measured continuously by wireless sensors on participants' work desks at their homes.

The four main IEQ parameters included in this study were overall illuminance (both daylight and artificial light), sound pressure level, temperature, and CO₂-concentration as a proxy for general air-quality. The distinguished workplace mental health (MH) concepts and corresponding measurement scales were obtained from a larger research project at the authors' university (see acknowledgements). This included *stress, fatigue, sleep quality, concentration, productivity, engagement, mental wellbeing, emotional exhaustion, depression, mood*. In addition, a *workplace satisfaction* measure was included. Distraction was covered by 6 questions on whether a participant was distracted by voices, movement of people around, children or incoming emails, phone calls or social media. Suitability of the workplace was questioned by 5 statements on different topics.

Data collection resulted in 36 MH surveys and 321 momentary PIT experiences, an average of almost nine

experiences per participant. Data sources were connected by means of pseudonyms in the surveys and timestamps from the sensor data.

In order to explore any significant relationships between pairs of variables, bivariate analysis was conducted. Secondly, the significant pairs were used as input for a path model. The path model enabled to analyze the interaction with the network of variables simultaneously.

RESULTS & DISCUSSION

The bivariate analyses have been conducted on both a participant level (using the cross-sectional survey, MH N=36) and the experience level (using the momentary survey, PIT N=321). The outcomes of those analyses showed no significant relations of the personal characteristics with any of the dependent variables, so these were not taken up in the path model. In addition, some of the workplace mental health concepts did not appear to depend on the workplace conditions and perceptions. Especially the sound levels and perceived noise showed multiple significant relations with mental health concepts, while no significant relations were found for the carbon dioxide concentration nor the satisfaction with air quality.

A follow-up path model showed acceptable goodness of fit indices (see Table 1) when including variable pairs significant on the 0.01 level from the bivariate analysis only. Moreover, low r-squared regressions and insignificant paths have been excluded from the model stepwise. Because one critical rule of thumb was breached (a minimum of 200 cases), the outcomes provide insights and give direction to future research but must be interpreted with care.

Table 1. Path model goodness of fit indices

Degrees of freedom	34
Chi-square	0.168
Chi-square/degrees of freedom	0.005
Comparative Fit Index (CFI)	0.989
Root mean square error of approximation	0.027
P-value for test of close fit (RMSEA < 0.05)	0.941
Standardized Root Mean Square Residual	0.038

The path model outcomes are visualized in Figure 2. The findings indicate that both subjective experience and objective IEQ conditions, as well as workplace *suitability* and *distraction* are related to workplace mental health.

First of all, the path model demonstrates higher *engagement* when working in a well-illuminated workplace (>572 lux, 0.14 and 0.16). Also, being distracted negatively affects the level of *engagement* (-.34) and self-reported *mental wellbeing* (-.19) as well. A self-perceived *suitable* workplace at home leads to diminished *fatigue* (-.38), which improves *Mental wellbeing* (-0.40). Higher levels of *engagement* increases *mental wellbeing* too. On the contrary, *fatigue*

would result in diminished *concentration* (-.18) which results in decreased *productivity* (.78). An average *sound pressure level* above 58dB resulted not only in diminished satisfaction with the noise level (-.10) but also in a decreased mood (more tension arousal, -.16). Being satisfied about the noise level increases *concentration* (.20), *self-reported wellbeing* (.16), *engagement* (.10), and diminishes *tense arousal* (-.14).

This study has a few limitations. First, the use of CO₂-concentration as a proxy for air quality at the workplace at home is questionable. Since odors; volatile organic compounds (VOCs); and fine particle matters (PMs) might play a crucial role as well. The CO₂-concentration is mainly a proxy related to the number of people, and thus more suitable to measure the office environment. Also, it should be noted that the current study was executed during governmental stay-at-home orders due to the Covid-19 pandemic. This situation is very different from being able to freely choose your work location. In addition, this study did not account for reduced mental wellbeing of participants due to the Covid-19 situation. Nonetheless, this research stresses the importance of IEQ for supporting workplace mental health both for employers and employees. The outcomes give insights in valuable interventions concerning noise and/or lighting levels to increase mental wellbeing of employees. Which potentially results in increased (business) performance as well.

CONCLUSIONS

This study is one of the first to explore workplace mental health in relation to multiple and both objective and subjective IEQ conditions in the home workplace environment. Although the results should be validated with larger samples, the outcomes give valuable insights in the complex network of variables influencing employee mental health. Since working from home is expected to be more common in a post-Covid world, the relevance and importance of future research is obvious. Future research could make a comparison between working in an office and at home in relation to both work-life balance and workplace mental health.

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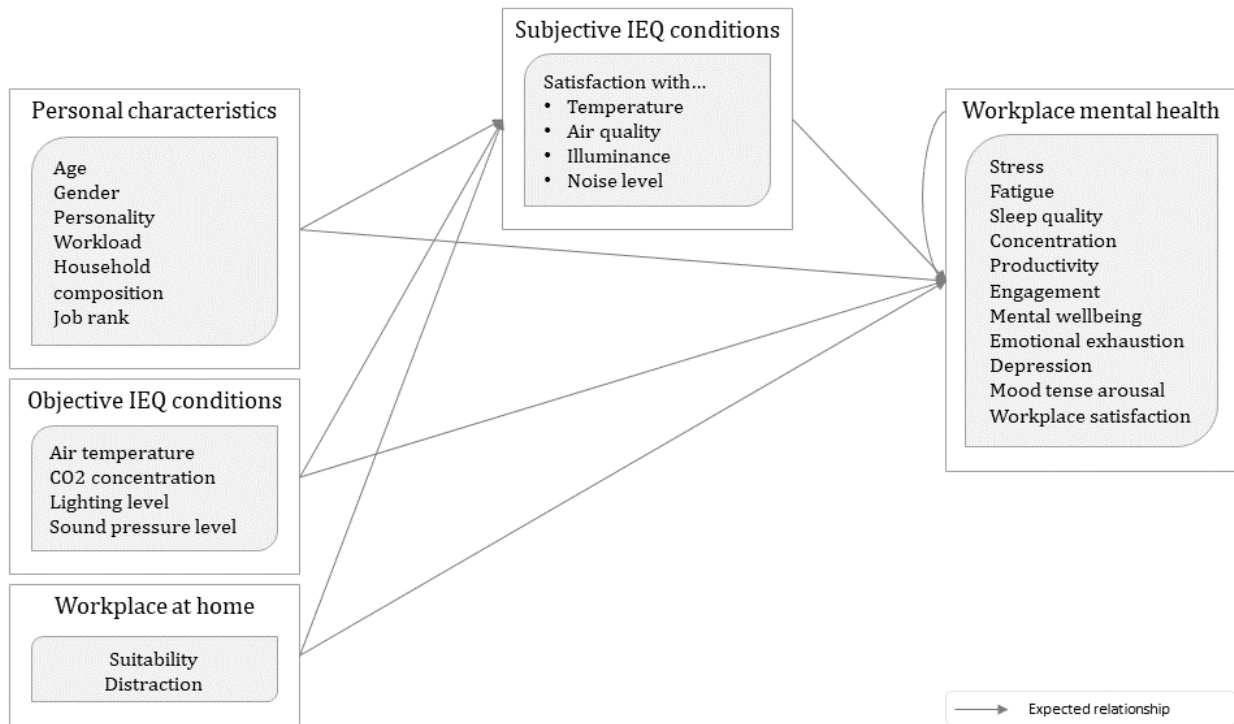


Figure 1. Visualization of the conceptual model.

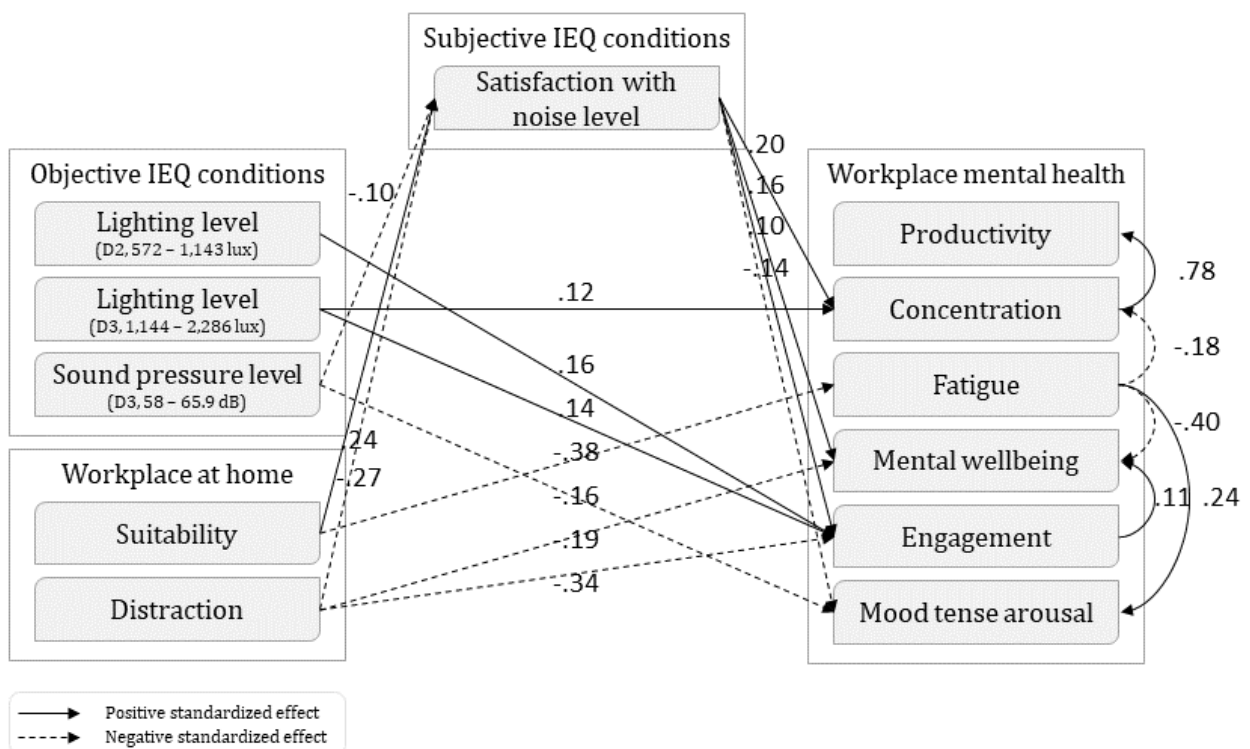


Figure 2. Visualization of path model outcomes.