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The influence of distractions of the home-work environment on mental health during the COVID-19 pandemic

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ABSTRACT

Previous research showed that office workers are mainly distracted by noise, influencing their mental health. Little investigation has been done into the influence of other workspace characteristics (i.e. temperature, amount of space, visual privacy, adjustability of furniture, wall colours, and workspace cleanliness) on distractions at the office, and even fewer while working from home (WFH). The influence of home-workspace distractions on mental health also received limited attention. This research aims to investigate relationships between home-workspace and personal characteristics, distraction, and mental health while WFH during COVID-19. A path analysis approach was used, to find that, at home, employees were distracted by noise and when having a small desk. Those with a dedicated workroom were less distracted. Distractions mediated most relationships between home-workspace characteristics and mental health, while personal characteristics influenced mental health directly. Employers can use these results to redesign policies regarding home-and-office working to stimulate a healthy work environment.

Practitioner summary: The investigation of the influence of home-workspace characteristics on distractions and mental health while WFH during COVID-19 appears to be limited. This research filled this gap by performing a path analysis, using a holistic definition of mental health. Findings showed that distractions mediate relationships between home-workspace characteristics and mental health.

Abbreviation: WFH: working from home

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Working from home; mental health; workspace distractions; COVID-19 pandemic; noise

1. Introduction

The outbreak of the COVID-19 pandemic in March 2020 forced office workers to start working from home (WFH) full-time, to safeguard people's health and well-being (Awada, Lucas, et al. 2021). Before the pandemic, WFH full-time was uncommon, occurred on an occasional, voluntary basis, and was only performed for certain types of work (Xiao et al. 2021). For instance, WFH was preferred among employees with a dedicated workroom because of fewer distractions (Awada, Lucas, et al. 2021). In contrast, people who shared their home-workspace, or those who did not have adequate ergonomic furniture, were more distracted from their job at home (Awada, Lucas, et al. 2021; Galanti et al. 2021). Distractions in the domestic environment, such as ringing doorbells, or children and pets making noise, could interrupt people when

working (Toniolo-Barrios and Pitt 2021; Moretti et al. 2020). Such distractions might also influence employees' well-being, productivity, and concentration (Galanti et al. 2021; Toniolo-Barrios and Pitt 2021).

Next to having a shared or dedicated room and ergonomic furniture, several other workspace characteristics can cause distractions. At the office, high noise levels or extreme temperatures have been reported as distracting (Haapakangas et al. 2018; Clements-Croome 2006). Employees use several mechanisms to cope with these distractions, such as wearing headphones, coming to work earlier, or WFH (Oseland and Hodsman 2018). However, the same factors may also distract employees from their work at home, depending on their satisfaction with the visual and thermal environment, the air quality, or the noise level (Xiao et al. 2021). In addition, Cuerdo-Vilches,

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Navas-Martín, and Oteiza (2021) found that the perceived suitability of a home-workspace depends mainly on the room size, the availability, and quality of artificial and natural light, the temperature, noise insulation, and furniture. Such home-workspace characteristics are found to predict employees' mental health, including their sleep quality, stress, mood, and concentration (Awada, Becerik-Gerber, et al. 2021).

Only a few studies focussed specifically on the influence of the physical home-workspace design on distractions and well-being. Xiao et al. (2021) showed satisfaction with physical home-workspace characteristics related to perceived distractions, but they did not include objective workspace design aspects, such as desk size and wall colours. They did confirm that distractions at home relate to mental well-being. Others mentioned the importance of windows and views outside to recover from stress, the adaptability of light levels to support different space-uses, the indoor air quality (i.e. natural ventilation), and the access to nature for employees' well-being while WFH during the COVID-19 pandemic, but not in light of perceived distractions (Peters and Halleran 2020). While such studies gained valuable insights, they have not addressed in full the mechanism underlying objective home workspace design in relation to perceived distractions and mental health while WFH. In addition, personal characteristics must be included, because, for instance, neurotic employees might be more prone to noise disturbance, which could distract them from their job and influence their mental well-being (Oseland and Hodsman 2018; Seddigh et al. 2016).

As Sander, Caza, and Jordan (2019a) argued, the role of distractions in the physical work environment should be considered since it will have important office-design implications. This might also be true for the home workspace, especially now that hybrid working seems to become the new standard (Chafi, Hultberg, and Yams 2021). Therefore, the aim of this study was to gain additional insights into the complexity of relationships between physical home-workspace characteristics, personal characteristics, home-workspace distractions, and mental health while WFH during the COVID-19 pandemic. Ten indicators were used to measure mental health holistically, namely well-being, stress, depression, engagement, burnout, concentration, fatigue, mood, sleep quality, and productivity (Bergefurt et al. 2022). These authors included productivity in their mental health framework because it is an important aspect of human flourishing or -optimal functioning. The next section will explain

the variables that were included in the conceptual model, followed by the research approach and the results.

2. Literature review

2.1. Home-workspace distractions and mental health

Distraction refers to the extent to which employees are irritated by negative or undesirable stimuli (Lee and Brand 2010). Distractions might draw office workers' attention away from the primary task that should be performed, which might cause an attentional conflict between the primary task and the distraction (Sanders, Baron, and Moore 1978). Continuous work distractions may have detrimental effects on people's health because office workers need to engage in coping strategies constantly. The more distractions employees experience in their work, the lower their experience of control over their work is (Keller et al. 2020). As a result, employees who are disturbed have fewer cognitive resources available to finish their current work tasks (Leroy 2009).

For knowledge workers, distractions at the office have been shown to lead to reduced productivity, increased stress levels, fatigue, and a more negative mood, because their work activities are usually characterised by high levels of complexity and non-routine tasks (Zijlstra et al. 1999). Requirements for performing complex work tasks are the ability to shield off distractions (Sörqvist et al. 2016) to work productively, focussed, and concentrated (Sander, Caza, and Jordan 2019b). To reduce the number of distractions in open offices, the activity-based workplace, that allows employees to choose the most appropriate workplace for a task concept, is introduced more frequently in recent years (Groen et al. 2019). This concept aims to increase employees' concentration and productivity level by reducing the frequency of interruptions (Engelen et al. 2019). Other mechanisms to cope with distractions are wearing headphones, coming to work earlier, taking a break, or WFH (Oseland and Hodsman 2018).

Generally, homeworkers are expected to experience fewer distractions than at the office, because they are not disturbed by their colleagues (Awada, Lucas, et al. 2021). However, for homeworkers who share their workspace with other household members, the number of distractions and mental health issues might actually increase (Xiao et al. 2021). Xiao et al. (2021) argued, for instance, that employees with children at home during the COVID-19 pandemic experienced

more distractions, which resulted in them reporting more mental health issues than before WFH (e.g. anxiety, depression, stress, trouble concentrating). Under these circumstances, more home-workspace distractions might be experienced that could subsequently influence employees' mental health. The following hypothesis is therefore posed:

H1: Home-workspace distractions are related to mental health indicators.

2.2. Physical home-workspace characteristics

Previous research indicated that physical workspace characteristics influenced the presence, nature, and frequency of workspace distractions at the office. Kim and De Dear (2012) called these characteristics basic factors, consisting of temperature, noise level, amount of space, visual privacy, adjustability of furniture, colours, and workspace cleanliness. These characteristics should be of relatively high quality to ensure employees' satisfaction with the workspace. While WFH, employees may have more responsibility and control to arrange these workspace characteristics according to their preferences to reduce distractions, although this may not necessarily hold for all (e.g. those living in smaller houses, with housemates and adolescents also WFH, and particularly those with younger children at home) (Xiao et al. 2021).

2.2.1. Temperature

Distractions can be caused by discomfort and stress from ambient conditions, such as high indoor temperatures (Clements-Croome 2006; Roper and Juneja 2008). Office temperatures above 28°C are experienced as unpleasant and distracting (Lipczynska, Schiavon, and Graham 2018). According to Varjo et al. (2015), the indoor temperature should range between 21 and 25°C to decrease distractions. While WFH, office workers may, although again not always, have more control over the temperature than at the office, which might have a positive influence on their subjective experience of the work environment (Sander, Rafferty, and Jordan 2021). Especially during the COVID-19 pandemic, the temperature was an important contributor to the suitability of the home-workspace (Cuerdo-Vilches, Navas-Martín, and Oteiza 2021). In the absence of air conditioning or circulating systems at home, employees' perception of air quality and humidity was lower, which also reduced their sleep quality and productivity (Buomprisco et al. 2021). However, when employees were satisfied with the thermal environment, they also rated their mental

well-being (Xiao et al. 2021) and productivity (Awada, Lucas, et al. 2021) more positively.

2.2.2. Noise

Office-related noise - conversations between colleagues, background noise, e-mails, and phone calls coming in - and a lack of speech privacy increase workspace distractions (Haapakangas et al. 2018; Haynes, Suckley, and Nunnington 2017). High intelligibility (i.e. irrelevant speech) increases the mental demand on employees and is observed as even more disturbing than background noise (Liebl et al. 2012). The noise of digital technologies, such as smartphones or e-mail notifications, could also distract people from their primary work tasks (Montag and Walla 2016), which might eventually cause impaired cognitive functioning and work performance (Duke and Montag 2017). Such sources of noise may all be less frequent when WFH, yet homeworkers might be distracted by other noise sources than at the office. Noise from doorbells, visitors, or telephones ringing, conversations between household members or sounds from televisions could distract employees (Jensen 2007; Ng 2010) and reduce their concentration (Puglisi et al. 2021). In contrast, other noise sources, such as natural and outdoor sounds, might increase their work engagement and well-being by alleviating feelings of loneliness due to the pandemic (Torresin et al. 2022).

2.2.3. Amount of space and shared/private space

High-density workspaces with limited space between workstations have been reported to increase cognitive overload and reduce psychological privacy (de Croon et al. 2005). Especially in open-plan offices, visual privacy [i.e. the ability not to be observed (Veitch 2018)], acceptable workstation size and sufficient distance between colleagues are often lacking (Kaarlela-Tuomaala et al. 2009). In larger workspaces, the distance between colleagues is generally larger, resulting in more visual privacy. People might therefore be less distracted from their job (Charles and Veitch 2002). In contrast, at home, some workers might not have a dedicated workspace or desk (Hill, Ferris, and Mårtinson 2003), and therefore use a spare bedroom or a small part of the living room as their workspace (Steward 2000). These spaces are often shared with others, which could increase the frequency of distractions (Awada, Lucas, et al. 2021), and reduce employees' productivity (Awada, Lucas, et al. 2021; Puglisi et al. 2021). As Seva, Tejero, and Fadrihan-Camacho (2021) argued, employees who shared their home-workspace were more stressed, tense, and irritated,

because they had to switch locations more frequently (e.g. when the dining table is needed to serve lunch/dinner).

2.2.4. Furniture

Vischer (2007) argued that ergonomic furniture at the office has been applied to protect employees from musculoskeletal problems and disorders. Employees who work in flexible offices complain more about the furniture and about postural problems, such as neck, back, and shoulder pains than employees in fixed-desk offices (Kim et al. 2016). Furniture that can be adjusted to personal preferences might increase employees' satisfaction with the workspace (Marquardt, Veitch, and Charles 2002). At home, such adjustable tables and chairs might not be present (Janneck et al. 2018). Janneck et al. (2018) argued that uncomfortable seating is one of the main distracting factors while WFH. The presence of adjustable chairs at home could reduce musculoskeletal problems (Awada, Lucas, et al. 2021), and decrease stress (Seva, Tejero, and Fadrilan-Camacho 2021). Seva, Tejero, and Fadrilan-Camacho (2021) showed that not only the adjustability of the chair, but also the comfort of the keyboard, the position of the monitor, and the size of the desk could influence employees' stress levels significantly.

2.2.5. Wall colours

Kwallek et al. (1997) found that white-coloured offices are experienced as less distracting and stressful than red- and green-coloured offices, while blue colours have a calming effect (Connellan et al. 2013). In general, the saturation of red and green colours is higher, and therefore employees might have more issues with narrowing their attention to the primary task, which could result in distractions. To the best of the authors' knowledge, no research so far has been performed on the influence of wall colours at home on employees' distraction and mental health. It is expected that, in line with office findings, white-wall colours are least distracting and support employees' mental health most.

2.2.6. Cleanliness

Last, workspace cleanliness might influence employees' distractions, while also influencing their productivity (Horrevorts, van Ophem, and Terpstra 2018). Kim and de Dear (2013) argued that employees in all office types are satisfied with the cleanliness of the workspace, but when sharing a desk with others, the presence of unclean desks may decrease their productivity (Kim et al. 2016). Piles of paper, notes, or to do lists on the desk might especially be distracting because

these introduce too many physical stimuli in the workspace. Furthermore, cluttered workspaces, with unemptied bins, old coffee cups, and loose papers, might also distract people from their primary job (Davis 1984). Research on the influence of workspace cleanliness on distractions while WFH has, until today, not been conducted. It is expected that unclean and untidy workspaces at home can distract employees from their primary job and reduce their mental health. Hence, the following two hypotheses are posed:

H2: Temperature, noise level, amount of space, visual privacy, adjustability of furniture, colours, and workspace cleanliness are related to home-workspace distractions.

H3: Temperature, noise level, amount of space, visual privacy, adjustability of furniture, colours, and workspace cleanliness are related to mental health indicators.

2.3. Personal characteristics

Personal characteristics are likely to play a role in the experience of distractions and mental health while WFH. For instance, younger-aged employees have been reported to experience increased stress and reduced productivity and well-being levels while WFH in comparison to older employees. Younger employees possibly feel a need to prove themselves, or they can cope less well with the stressors and distractions of WFH (Awada, Lucas, et al. 2021; Seva, Tejero, and Fadrilan-Camacho 2021; Shokrkon and Nicoladis 2021). Furthermore, because younger employees usually live in smaller houses, they are mainly found to work from their bedroom, in the absence of a dedicated workroom (Tagliaro and Migliore 2021). Younger-aged employees might also have younger children, who had to stay at home during the COVID-19 lockdowns due to the closure of schools and day-care. Parents had to perform home-schooling for their children, and also had to work from a chaotic home-work environment (Xiao et al. 2021). Especially these employees were distracted from their job and indicated reduced work efficiency (Awada, Lucas, et al. 2021; Aczel et al. 2021). Due to greater work-family conflicts and more stress, these employees also indicated reduced productivity and work engagement (Galanti et al. 2021). Those with teenage children were less distracted, because teenagers usually are more independent, and can help their parents with household duties (Xiao et al. 2021).

Furthermore, it was found that females rated their mental health poorer than males during the COVID-19 pandemic, this included lower well-being and

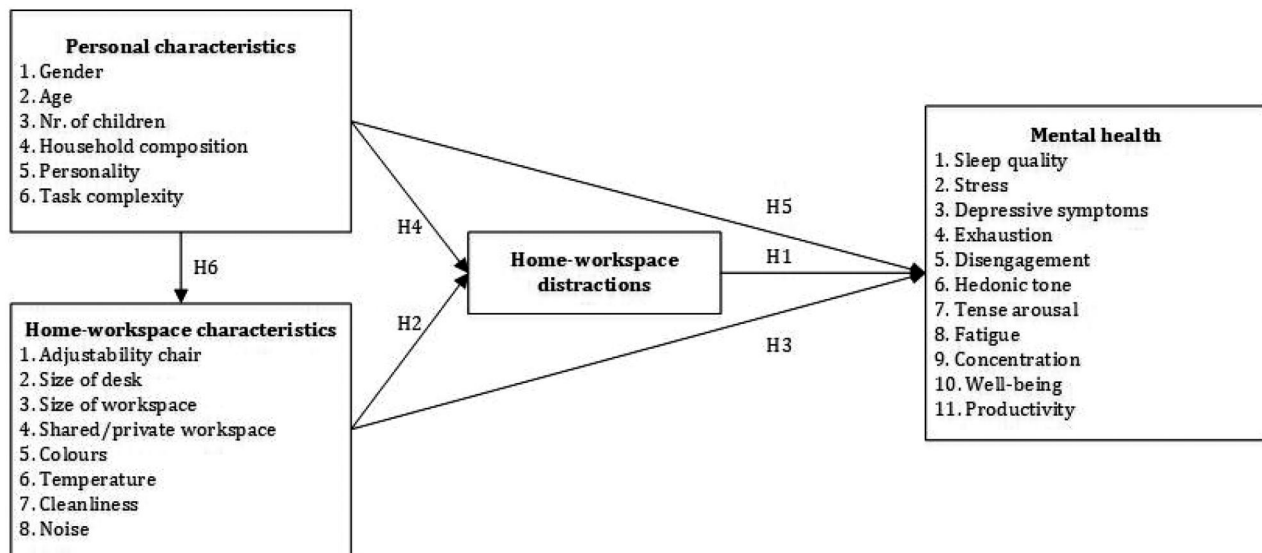


Figure 1. Conceptual model.

sleep quality, and higher levels of stress, depressive symptoms, and anxiety (Pieh, Budimir, and Probst 2020; Cellini et al. 2021). The pandemic might have increased the disbalance between work and family responsibilities of males and females (Matli 2020). In most dual-career families, females took care of their children when childcare and schools were closed (Feng and Savani 2020). Females' reduced mental health during the pandemic might also be caused by their sensitivity to auditory and visual distractions, which has, until today, only been observed in the office environment (Haynes, Suckley, and Nunnington 2017; Pullen 2014). As Blasio et al. (2019) showed, females were more likely to be annoyed by irrelevant speech noise than males in open-plan offices. This might also be the case while WFH.

Stressful events, such as the COVID-19 pandemic, particularly reduce the mental well-being of neurotic employees (Shokrkon and Nicoladis 2021) and increase their stress (Liu et al. 2021). Extrovert employees were also more stressed while WFH, but are generally better capable to adjust to life-changing events, such as the pandemic (Shokrkon and Nicoladis 2021; Liu et al. 2021). Insufficient indoor environmental quality of the office-work environment was also found to increase extroverts' stress levels (Kallio et al. 2020). In general, conscientious employees are most satisfied with WFH, because they are highly organised and can work independently (Smith, Patmos, and Pitts 2018). At the office, they are usually less easily distracted from their job (Seddigh et al. 2016; Eysenck and Graydon 1989), while neurotic employees are found

to be most distracted by office noise (Oseland and Hodsman 2018).

Last, people who performed complex work tasks were more distracted. During complex work, when the number of information cues increases, it becomes harder to complete relevant work tasks, because employees' cognitive capacity decreases (Speier, Vessey, and Valacich 2003). As Zajonc (1965) explained, the dominant response is incorrect when one performs a complex task. Arousal then impairs the work performance of the individual. Several environmental factors, such as the noise, temperature, and density of the workplace, could influence arousal (Farshchi and Fisher 2006). However, in the absence of workspace distractions, employees who performed complex tasks were found to be more engaged and productive, because they considered their job to be challenging instead of demanding (Roskams et al. 2019). Regarding personal characteristics, the following hypotheses are therefore drawn:

H4: Gender, age, number of children, household composition, personality, and task complexity are related to home-workspace distractions.

H5: Gender, age, number of children, household composition, personality, and task complexity are related to mental health indicators.

H6: Gender, age, number of children, household composition, personality, and task complexity are related to temperature, noise level, amount of space, visual privacy, adjustability of furniture, colours, and workspace cleanliness.

Table 1. Measures and Cronbach's alpha.

Concept	Scale/survey	References	Cronbach's alpha
Well-being	Health at Work Survey of WHO	WHO 2001	–
Productivity	Health at Work Survey of WHO	WHO 2001	–
Stress	Stress and worry	Beute and de Kort 2018	0.86
	Four-item Patient and Health Questionnaire for Depression and Anxiety (PHQ-4)	Kroenke et al. 2009	
Depressive symptoms	PHQ-4	Kroenke et al. 2009	0.80
Disengagement	Oldenburg Burnout Inventory (OLBI)	Demerouti and Bakker 2007	0.78
Exhaustion	OLBI	Demerouti and Bakker 2007	0.82
Concentration	Checklist individual strength (CIS)	Beurskens et al. 2000	0.79
Fatigue	CIS	Beurskens et al. 2000	0.90
Sleep quality	Single-item sleep quality scale (PSQ)	Snyder et al. 2018	–
Hedonic tone	UWIST Mood Adjective Checklist	Matthews, Jones, and Chamberlain 1990	0.84
Tense arousal	UWIST	Matthews, Jones, and Chamberlain 1990	0.83
Personality	10-item Big Five Inventory (BFI)	Rammstedt and John 2007	–
Task complexity	Perceived Task Complexity Scale	Maynard and Hakel 1997	0.86
Noise		Vischer 2005	0.75
Wall colours		Ainsworth, Simpson, and Cassell 1993	–
Temperature		ISO 7730	–
Home-workspace distraction	Distraction Scale	Lee and Brand 2005	0.79

2.4. Conceptual model

The conceptual model in Figure 1 shows the expected relationships between personal characteristics, home-workspace distractions, home-workspace characteristics, and mental health indicators. Internal relationships between the mental health indicators are also expected, as described by Bergefurt et al. (2022). Therefore, the following hypothesis is added:

H7: Sleep quality, stress, depressive symptoms, exhaustion, disengagement, hedonic tone, tense arousal, fatigue, concentration, well-being, and productivity are related to each other.

3. Methods

3.1. Data collection

To study the relationships between personal characteristics, home-workspace characteristics, distractions during work, and mental health indicators, data were collected in a cross-sectional survey study. The survey was distributed via e-mail to the corporate real estate team of a large [nationality disclosed for blind peer review] technology company. This team was asked to distribute the link to the online survey to their colleagues so that all employees could respond to the questionnaire. Furthermore, the research was presented to different community groups (i.e. seniors and workers on the autism spectrum) within the company to obtain a diverse sample of knowledge workers. So, a convenience sampling method was used, which means that people could voluntarily fill in the survey. The sample

might therefore not be representative of the population, and results should be carefully interpreted before generalising it to other contexts or samples. Nonetheless, this was the most optimal approach within the restrictions of this firm. Mental health is a delicate topic and therefore organisations are hesitant to spread such surveys widely. To ensure anonymity, questionnaires were submitted directly to the researchers. This company was targeted because it is one of the most fast-growing companies in the region, which also financially supports an overarching research project to which this study belongs. Data were collected between November and December 2020. A much-cited recommendation is that for each parameter, at least 10 cases should be obtained (Kline 2011). For the conceptual model, shown in Figure 1, the sample size should be at least 260. The final sample size of 271 thus satisfied the a priori condition.

3.2. Measures

Table 1 shows the scales that were used to measure 10 relevant mental health indicators, as introduced by Bergefurt et al. (2022), the home-workspace characteristics, distractions, and personality. The table also shows the Cronbach's Alpha scores, that were used to test the internal consistency of the set of items for each factor (more than two variables). In addition, the following demographics were probed: gender, age, number of children (incl. no children), household composition (single/living alone, married/living together, other), and task complexity. The 10 mental health

Table 2. Inter-item correlation of personality.

Personality	Inter-item correlation
Extraversion	0.38
Neuroticism	0.56
Conscientiousness	0.27
Agreeableness	0.17
Openness	0.081

indicators represent a range of short-lived to more chronic, and positively as well as negatively valenced states/conditions (see Table 1, for scale ranges and descriptives, see Table 2). Workspace characteristics were measured with mostly 1-item, *ad-hoc* developed categorical scales (see Table 2). Distractions were measured with the Lee and Brand (2005) distraction scale; personality dimensions were probed with the 10-item Big Five Personality scale. For multi-item scales, Cronbach's Alpha (α) should be between 0.7 and 0.9 (Tavakol and Dennick 2011), for two-item scales the inter-item correlation should be between 0.2 and 0.4 (Field 2017).

For stress, two items (i.e. Feeling nervous, anxious, or on edge; not being able to stop or control worrying) of the Four-item Patient and Health Questionnaire for Depression and Anxiety (PHQ-4) were combined with two items (i.e. Feeling stressed; ruminating/agonising over things) of the Stress and Worry scale by Beute and de Kort (2018). The Cronbach's Alpha of 0.86 indicated high internal consistency of the set of items. Furthermore, the inter-item correlations of the personality dimensions agreeableness and openness were extremely low. Therefore, these items were dropped from further analyses.

3.3. Analytical approach

First, bivariate analyses were conducted to get insights into the significance of direct relationships between variables (Field 2013). Both internal, as well as external relationships, were tested, except for the internal relationships between personal characteristics. The significant internal and external relationships were then used as input for the path analysis. Path analysis is a special case of structural equation modelling (SEM), in which multiple direct and indirect relationships between independent and dependent variables are determined simultaneously. All relationships that were found to be insignificant at the 0.05 ($t < 1.96$) significance level were deleted from the path model to overcome the risk of an overfitted model. This backward stepwise process was repeated until an acceptable model was found and all insignificant relationships were removed from the path model (Streiner 2005; Hu, Bentler, and Hu 1999). The

statistical package Lavaan was used in RStudio to conduct the path analysis (Rosseeel 2012).

4. Results

4.1. Sample descriptives

Table 3 shows that almost 80% of the sample was male with a mean age of 47. The high percentage of male workers is consistent with the case organisation's employee base. Most employees indicated to live without children, while those who lived with children more frequently had two children or more. Moreover, almost 77% of the sample indicated to be married or to live together. On average, employees scored moderately high on conscientiousness, followed by extraversion and neuroticism, respectively. Furthermore, the work tasks of respondents were rather complex.

Table 3 also shows the descriptive statistics for physical workspace characteristics. First, most employees had an adjustable office chair and a medium-sized desk. A large share worked in a small, dedicated workroom that they did not have to share with others. Most work settings at home had neutral- or white-coloured walls. The mean temperature at home was slightly cool to neutral, the mean workspace cleanliness was rather low, and the mean noise at home was somewhat uncomfortable.

More specifically, among the respondents who worked in another type of work setting ($N = 22.5\%$), most were male (73.8%) with a mean age of 45, had no children (54.1%), indicated to work in a small workspace (47.5%), used a regular chair (60.7%), had a medium-sized desk (59.0%), and had white wall colours (57.4%). They were somewhat more negative about the noise level ($M = 1.97$, $SD = 0.83$) and temperature ($M = 3.82$, $SD = 1.00$) at home than the total sample. They were also somewhat more distracted ($M = 2.53$, $SD = 0.70$). Especially the difference in the use of a regular chair between the respondents who worked in another type of work setting and the total sample is considerable.

Last, Table 3 shows the descriptives for the mental health indicators. On average, office workers rated their sleep quality, concentration, well-being, and productivity rather positively, and they were not stressed or fatigued, felt more calm, relaxed, happy, and satisfied than tense, nervous, sad, or low-spirited, and were not depressed, exhausted, or disengaged. Nonetheless, the larger standard deviations show that not all respondents perceived their mental health so positively. The distribution of depressive symptoms, stress, and productivity were somewhat skewed.

Table 3. Sample descriptives.

	Sample (N)	Sample (%)	Mean	SD
Personal characteristics				
Gender				
Male	215	79.7		
Female	55	20.3		
Age			46.90	11.99
Number of children				
No children	149	55.0		
One child	44	16.2		
Two or more children	78	28.8		
Household composition				
Single/ living alone	58	21.4		
Married/ living together	208	76.8		
Others	5	1.8		
Personality (1. Strongly disagree–5. Strongly agree)				
Conscientiousness			4.02	0.64
Extraversion			3.11	0.86
Neuroticism			2.61	0.87
Task complexity (1. Strongly disagree–5. Strongly agree)				
			3.79	0.75
Physical workspace characteristics				
Adjustability of chair				
Adjustable chair	161	59.4		
No adjustable chair	32	11.8		
Regular chair	78	28.8		
Size of desk				
Small desk (1 m ²)	62	22.9		
Medium desk (2 m ²)	173	63.8		
Large desk (4 m ²)	36	13.3		
Size of workspace				
Small workspace (<10 m ²)	115	42.4		
Medium workspace (10–15 m ²)	111	41.0		
Large workspace (>16 m ²)	45	16.6		
Privacy—type of workspace				
Dedicated room	134	49.4		
Dedicated area	76	28.0		
Other work setting	61	22.5		
Shared/private workspace				
Private	217	80.1		
Shared	54	19.9		
Colours				
Blue/green	32	11.8		
Red/warm	75	27.7		
White/neutral	164	60.5		
Temperature (1. Cold–6. Warm)				
			3.71	1.02
Workspace cleanliness (1. Cluttered desk–5. Very clean, empty desk)				
			2.71	1.16
Noise (1. Comfortable–5. Too much noise)				
			1.74	0.80
Home-workspace distraction (1. None of the time–5. All of the time)				
			2.11	0.63
Mental health				
Sleep quality (1. Low sleep quality–4. High sleep quality)			2.94	0.74
Concentration (1. Low concentration–7. High concentration)			4.38	1.19
Well-being (0. Low well-being–10. High well-being)			6.78	1.55
Productivity (0. Low productivity–10. High productivity)			7.26	1.25
Hedonic tone (1. Happy, satisfied–4. Sad, low-spirited)			1.93	0.70
Tense arousal (1. Calm, relaxed–4. Tense, nervous)			2.01	0.68
Fatigue (1. Low fatigue–7. High fatigue)			3.28	1.26
Stress (1. Low stress–4. High stress)			1.62	0.62
Depressive symptoms (1. Few symptoms–4. Many symptoms)			1.47	0.63
Exhaustion (1. Low exhaustion–4. High exhaustion)			2.19	0.49
Disengagement (1. Low disengagement–4. High disengagement)			2.23	0.46

4.2. Path analysis

Paths were specified according to the results of the bivariate analyses, which showed that all variables were related to at least one other variable. During the path analysis, the following variables were deleted because they were not significantly related to any other variable: gender, age, conscientiousness, extraversion, adjustability of chair, temperature, size of

workspace, having a shared/private workspace, and cleanliness.

Various models were composed by adding and deleting paths until an acceptable model fit was found, with consideration of existing theory from the literature review.

Table 4 shows the goodness of fit statistics of the hypothesised model. The Goodness of Fit Index (GFI =

Table 4. Goodness of fit statistics.

Degrees of freedom (<i>df</i>)	118
Chi square (χ^2)	177.66
Root Mean Square Error of Approximation (RMSEA)	0.043
Akaike Information Criterion (AIC)	6630.12
Bayesian Information Criterion (BIC)	6835.44
Comparative Fit Index (CFI)	0.97
Non-Normed Fit Index (NNFI)	0.96
Goodness of Fit Index (GFI)	0.92

0.92), the Non-Normed Fit Index (NNFI = 0.96), and the Comparative Fit Index (CFI = 0.97) should all be close to 1 (Schermelel-Engel, Moosbrugger, and Müller 2003). GFI indicates the fit between the hypothesised and the observed proportion of variance. NNFI measures the discrepancy between χ^2 of the hypothesised model and χ^2 of the null model and solves the biases of the Normed Fit Index (NFI). CFI examines the discrepancy between data and hypothesised model, while adjusting for small sample size issues. Furthermore, the root mean square error of approximation (RMSEA = 0.043) should be below 0.05 and indicates the square root of population misfit per degree of freedom (Hayashi and Yuan 2011). Both AIC and BIC show the estimation of prediction error in the hypothesised model but use a different penalty for the number of parameters. The AIC and BIC measures can be used to compare competing models and should be as low as possible (Schermelel-Engel, Moosbrugger, and Müller 2003), which was the case for the hypothesised model.

4.3. Direct relationships—home-workspace characteristics

Figures 2 and 3 show the significant relationships that were found in the path analysis. They show the same overall path model, but the relations between the 10 mental health indicators are shown separately in Figure 3 for clarity-reasons. Several home-workspace characteristics were significantly related to home-workspace distractions (see Figure 2 and Table 5). First, employees who had a dedicated workroom at home were less distracted. Higher noise levels and having a small desk at home also distracted employees from their job. The influence of noise on home-workspace distractions was relatively large ($\beta = 0.44$). Hypothesis 2 can thus partly be accepted because three workspace characteristics were related to home-workspace distractions. Furthermore, it was found that those who indicated the noise level as being too high less frequently had a dedicated workroom at home. Surprisingly, employees who had blue or green wall colours were more stressed, but these colours also

increased their happiness and satisfaction (i.e. hedonic tone). High noise levels were also found to reduce employees' well-being. Because other direct relationships between home-workspace characteristics and mental health were not found, Hypothesis 3 could partly be accepted.

Several direct relationships were found between home-workspace distractions and mental health. First, it was found that home-workspace distractions reduced employees' productivity and concentration levels. As a result of distractions, employees rated their stress levels to be higher and indicated reduced hedonic tone. Employees felt more sad and low-spirited when they were distracted from their job. Hypothesis 1 could thus partly be accepted because home-workspace distractions were not related to all mental health indicators. Especially the standardised path coefficient between home-workspace distractions and stress was relatively large ($\beta = 0.31$).

4.4. Direct relationships—personal characteristics

Results showed that having more than two children increased home-workspace distractions while WFH. Hypothesis 4, which indicates a direct relationship between personal characteristics and home-workspace distractions, should thus partly be accepted. Furthermore, several direct relationships between personal characteristics and mental health could be observed. Employees with neurotic personality traits were more stressed and were also more tense and nervous (i.e. tense arousal). Especially the influence of neuroticism on stress was relatively large ($\beta = 0.49$). Employees who performed complex tasks were happier and more satisfied (i.e. hedonic tone), rated their productivity higher, and were more engaged. Hypothesis 5 could thus also partly be accepted because only some direct relationships were found. Last, employees who indicated to have more than two children were less likely to have a dedicated workroom at home. Therefore, Hypothesis 6 was also partly accepted.

4.5. Direct internal relationships—mental health characteristics

In Figure 3, concepts on the left represent more transient states, whereas concepts on the right represent more chronic states. First, employees who felt stressed felt more tense and nervous (tense arousal), low-spirited and sad (hedonic tone), exhausted, indicated more depressive symptoms, and rated their sleep

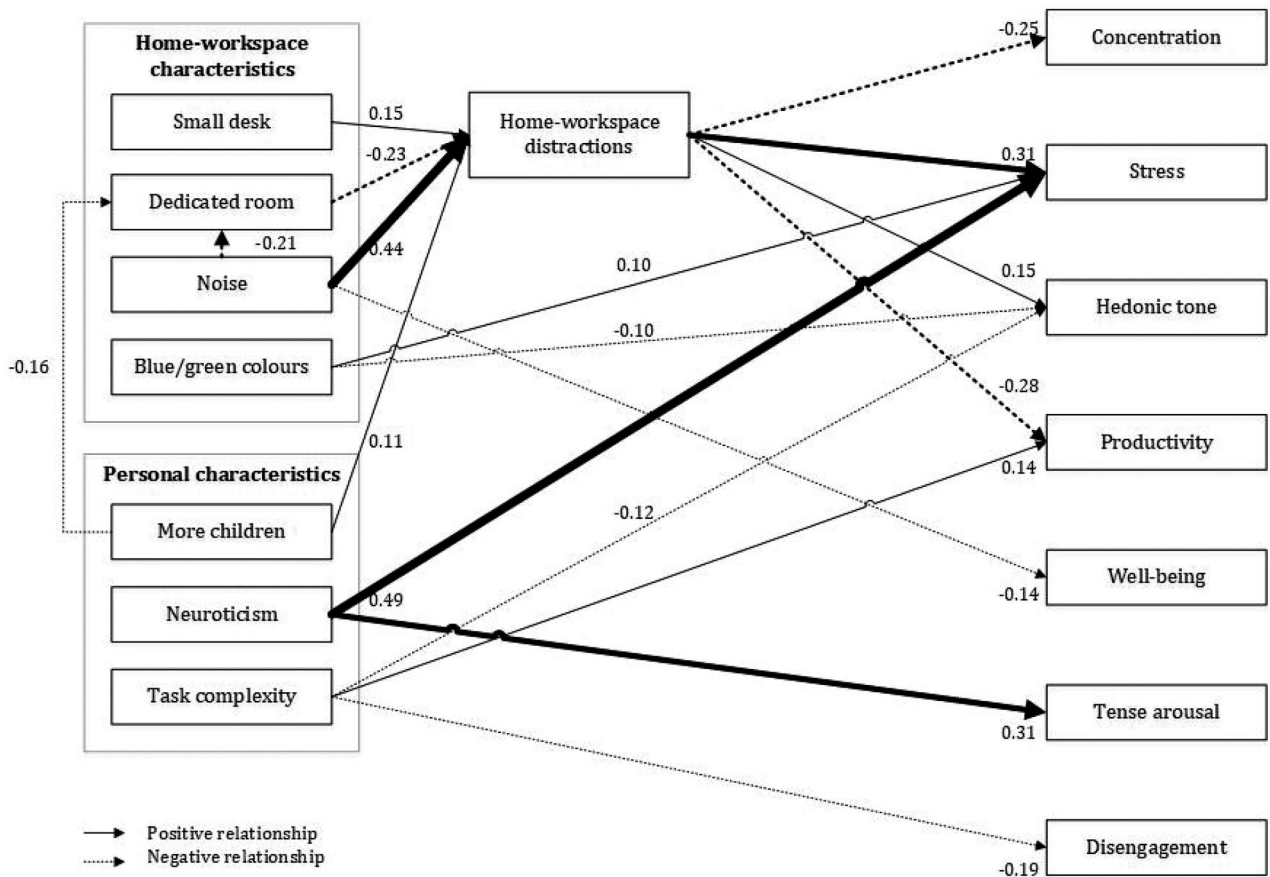


Figure 2. Path model—standardised significant relationships.

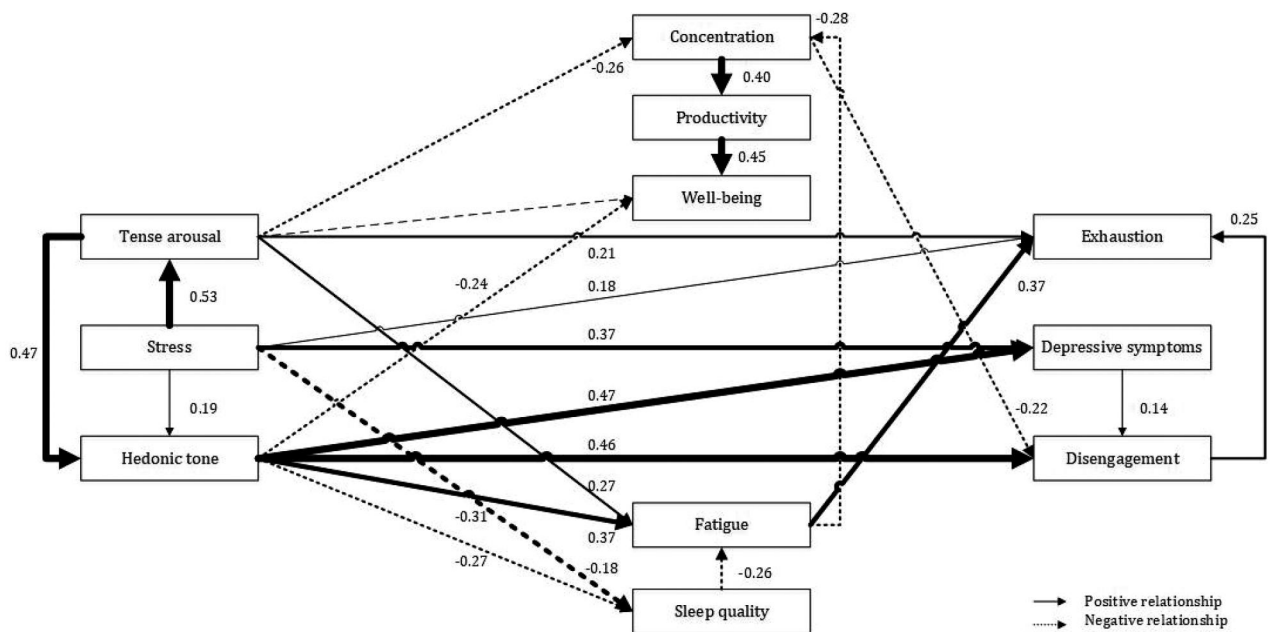


Figure 3. Path model—standardised significant relationships mental health.

quality poorer. The relationship between stress and tense arousal was relatively strong ($\beta=0.53$). Furthermore, employees who indicated to feel tense and nervous (tense arousal) were less concentrated, rated their well-being lower, felt more fatigued and exhausted, and indicated to feel low-spirited and sad (hedonic tone). The influence of tense arousal on hedonic tone was also relatively strong ($\beta=0.47$). Next, employees who felt sad and low-spirited (hedonic tone) indicated more depressive symptoms, felt more disengaged and fatigued, and rated their well-being lower. The relationships between hedonic tone and depressive symptoms ($\beta=0.47$) and disengagement ($\beta=0.46$) were also both relatively strong.

Notably, employees who rated their concentration higher perceived higher productivity and felt more engaged. The influence of concentration on productivity was rather large ($\beta=0.40$). Employees who rated their productivity higher also rated their well-being higher. This relationship was relatively strong ($\beta=0.45$). Those who rated their sleep quality higher felt less fatigued, and those who felt less fatigued were also more concentrated. Employees who indicated several depressive symptoms were more disengaged, and those who were disengaged felt more exhausted. Hypothesis 7 can therefore be accepted.

4.6. Indirect relationships

Indirect relationships via distractions on mental health were found for both personal and home-workspace characteristics. First, employees experienced lower noise levels when they had a dedicated workroom, resulting in less home-workspace distractions. Furthermore, employees who had more than two children were less likely to have a dedicated workroom and were, therefore, more distracted in their work. In addition, neurotic employees were more stressed, and as a result, felt nervous and tense (tense arousal). Those who performed complex tasks were found to be happier and more satisfied (hedonic tone), leading to more engagement in their job. Employees who were distracted from their job were more stressed, which reduced their satisfaction and happiness (hedonic tone). Last, home-workspace distractions lowered employees' concentration levels, leading to reduced productivity levels.

Other indirect relationships were found between mental health variables. Employees who felt stressed were more likely to feel tense and nervous (tense arousal), which resulted in them feeling low-spirited and sad (hedonic tone) or exhausted. Furthermore,

stressed employees felt sad and low-spirited (hedonic tone), which could decrease their sleep quality or increase depressive symptoms. In addition, employees who felt calm and relaxed (tense arousal) were more likely to feel happy and satisfied (hedonic tone), and therefore also rated their well-being higher. Employees who were happy and satisfied (hedonic tone), indicated fewer depressive symptoms, which resulted in more engagement in their job. Those who felt tense and nervous (tense arousal) also felt more fatigued, which reduced their concentration level. Last, employees who indicated to feel sad and low-spirited (hedonic tone) rated their sleep quality to be lower and were, therefore, more fatigued.

5. Discussion and limitations

This study aimed to understand the complexity of relationships between personal characteristics, physical home-workspace characteristics, home-workspace distractions, and mental health while WFH during the COVID-19 pandemic. After strong interdependencies between the mental health indicators and the relationship between neuroticism and stress, the strongest relationship was found between noise and distraction. This indicates that uncomfortable home-workspace noise could substantially distract employees from their job. Office research showed comparable findings, namely that noise from colleagues' conversations and telephones left ringing distracted employees in open-plan offices (Oseland and Hodsman 2018; Banbury and Berry 2005). Before the COVID-19 pandemic, employees who WFH voluntarily experienced fewer noise distractions at home than at the office (Oseland and Hodsman 2018). However, while office workers were obliged to WFH during the pandemic, home-workspace distractions increased (Xiao et al. 2021). As current results showed, especially homeworkers without a dedicated workroom or with a small desk were distracted from their job. One of the requirements for WFH thus seems to be having a dedicated workroom at home to work distraction-free (Awada, Lucas, et al. 2021; Xiao et al. 2021). Employees with a small desk might have limited space to store papers and ICT-related equipment (e.g. monitor, keyboard, mouse) which could distract them from their job as well.

Employees with more than two children were less likely to have a dedicated workroom and were more likely to experience home-workspace distractions. Such distractions reduced employees' concentration and productivity, and increased stress, and negative feelings (i.e. low-spirited and sad). Surprisingly, the

bivariate analysis showed that the number of children in the household did not relate to noise, but only directly to distractions. Although WFH might reduce distractions from colleagues (Awada, Lucas, et al. 2021), household members (especially young children) could also substantially distract employees from their job, especially when these household members were not allowed to attend school, day-care, or the office. Although WFH is a learning process in which both employees and employers should strive to reduce work-family conflicts (Galanti et al. 2021), it should be acknowledged that being forced to WFH without adequate facilities could not live up to the office experience. This not only reduces employees' productivity but could also put them at risk of experiencing stress-related outcomes in the long run (Song and Gao 2020).

Personality has been related to distractions and mental health states in earlier research. Office-based research usually shows that neuroticism has a strong relationship with distractions from (mainly) high noise levels (Oseland and Hodsman 2018). However, in the current home-based study neuroticism was not related to distractions, but only to stress and tense arousal. Stressful events, such as the sudden shift of working from the office to working from home, are especially detrimental for employees higher in neuroticism and might even reduce their mental well-being (Shokrkon and Nicoladis 2021; Liu et al. 2021). Matli (2020) suggested that regular social (online) interactions might be of particular importance for these employees, during and after the pandemic. Although it is still unknown whether this would meaningfully alleviate stress and tension, workplace managers might now have insights into who can WFH healthily, and for whom face-to-face interactions are more important.

Employees who performed complex tasks were found to be more productive and engaged in their job and rated their hedonic tone more positively (satisfied and happy) while WFH. Since the current sample consisted of knowledge workers who usually perform complex and non-routine tasks (Zijlstra et al. 1999), these results were not surprising. As Kahn (1990) indicated, people who perform challenging tasks and varied work are more likely to experience psychological meaningfulness, which results in higher job engagement. He argued that it is important to have some complexity in daily work tasks, to help to grow and learn, and to experience a sense of competence from routine tasks. This implies that employers should try to challenge employees in performing their job to stimulate their mental health.

Only two home-workspace characteristics influenced mental health directly. This indicates that home-workspace distractions are a strong mediating mechanism between home-workspace characteristics and mental health. Direct relationships were also expected between, amongst others, cleanliness and productivity (Horrevorts, van Ophem, and Terpstra 2018), noise and concentration, and fatigue (Kaarlela-Tuomaala et al. 2009), and temperature and stress (Kim et al. 2018), because these were significant in office-based literature. The relationship between noise and well-being has also previously been found in office-based literature. Especially in open-plan offices, high noise levels could lower employees' well-being (Otterbring, Bodin Danielsson, and Pareigis 2021). More surprisingly, employees with blue/green (cool) wall colours were more stressed, but these colours also increased their happiness and satisfaction (i.e. hedonic tone). The relationship between blue/green wall colours and stress is in contrast with previous research, in which blue and green were associated with peace, openness, concentration, comfort, and harmony (Mehta and Zhu 2009; Nag 2019). While previous studies mainly focussed on the office-environment with white as an appropriate wall-colour (Kwallek, Lewis, and Robbins 1988), van der Voordt, Bakker, and de Boon (2017) argued that people might be less aware of the wall colours at home, because they experience the colours unconsciously. However, during the pandemic, when employees were forced to WFH, they might have become more conscious of the wall colours again due to different use of rooms (e.g. living room or bedroom). Future research could investigate how colour use at the office and home influence employees' mental health (e.g. their concentration, mood, and stress).

The second part of the path model showed the relationships between 10 mental health variables, as introduced by Bergefurt et al. (2022). Current results confirm the findings of Bergefurt et al. (2022) that the 10 mental health variables form a holistic framework, with more transient, momentary feelings (left side of the path model) that may gradually evolve into chronic mental well-being or -ill-being (right side of the path model), depending on workspace-and personal characteristics.

Although valuable insights were gained from this study, some limitations need to be mentioned. First, a middle-aged, male-dominated sample was obtained. Although the overrepresentation of males is representative for the [nationality disclosed for review] technology sector, it might have affected the sample distribution of home-workspace characteristics. For instance, most

respondents indicated to have a private workspace, an adjustable, ergonomic chair, and a middle-sized desk. Ergonomic furniture was provided by the employer for those who needed it. Future research could explore whether employees who share their workspace with others or whose home-workspace is not ergonomically acceptable, are more distracted and rate their mental health lower. It is also interesting to observe whether a more equal gender distribution in different job sectors changes the experience of distractions and mental health, while females were found to rate their mental health poorer during the COVID-19 pandemic (Pieh, Budimir, and Probst 2020; Cellini et al. 2021). Future research could also explore whether findings are comparable in different cultural contexts. It is expected that distractions are even more prominent in cultures where large families live together under one roof.

Furthermore, the sample of this study was relatively small, which might have influenced the significance and strength of relationships in the path analysis. The variables depressive symptoms, stress, and productivity were also somewhat skewed. Although the *a priori* recommendation of at least 10 cases per parameter was satisfied, future research could repeat this study using larger sample size, containing employees from several (public or private) companies in different countries. Furthermore, it might be interesting to observe the influence of home-workspace characteristics on distractions and mental health after the COVID-19 pandemic, when employees might start to work more hybrid.

Future research could also obtain information about employees' satisfaction with other IEQ characteristics at home, such as (day)light, air quality, and ventilation. These characteristics might be related to distraction or mental health while WFH. Last, the COVID-19 pandemic caused a unique situation in which employees were obliged to WFH. It might therefore be hard to generalise the obtained results to situations after the pandemic. However, these insights are valuable for workplace managers and employers to redesign their home-and-office-workplace policies, to suit employees who prefer to WFH or from the office. More flexible regulations could support employees to work from their preferred work location, thereby reducing their experienced distractions.

6. Conclusion and recommendations

This study provided insights into the relationships between personal and home-workspace characteristics and distractions and mental health while WFH during the COVID-19 pandemic. A path analysis was

performed, to observe which direct and indirect relationships were significant. Results showed that various home-workspace characteristics caused home-workspace distractions, including having a small desk, a dedicated workroom, and noise. Distractions were found to mediate the relationship between home-workspace characteristics and mental health, while only one home-workspace variable, having blue/green wall colours, directly influenced mental health. Importantly, although only correlation inferences could be drawn from the current dataset, the findings do suggest that suboptimal workplace conditions, also when working from home, may lead to lower transient as well as chronic mental health states. Workplace managers should therefore consider more flexible workplace concepts and -policies that allow employees to choose where to work, and, in case work is forcefully located at home, to help employees create good conditions there. Such considerations could possibly reduce employees' experience of distractions, raise their productivity, and protect their mental health.

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