**Master Thesis**
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# Occupational Sedentary Behaviour During COVID-19 Regulations-Related Working From Home

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# Abstract[1]

**Purpose:** Sedentary behaviour is associated with detrimental long-term health effects, including chronic illnesses and all-cause mortality. Previous studies on occupational sedentary behaviour (OSB) in office workers focused on traditional offices. Meanwhile, teleworking becomes increasingly more common, and temporarily mandatory as per regulations following the COVID-19 pandemic. The purpose of this opportunistic study was to explore the amount of OSB, the experienced change in level of OSB since the homeworking regulations and the relationships between socioecological factors and these OSB outcomes in office workers forced to work from home due to COVID-19 regulations.

**Methods:** An online cross-sectional survey was filled out by 119 employees (academic staff, PhD students, and support and management staff) from a Dutch university. Measures related to OSB and experienced change in OSB (main outcomes), home office characteristics, instrumental attitude, perceived behavioural control, perceived ability to reduce OSB, social influences, factors related to breaks in sitting time, and changes in and consequences of work aspects at home. One-way variance analyses were used to determine differences in OSB and experienced change in OSB by sociodemographic and home office characteristics. Correlation and multiple linear hierarchical regression analyses were used to determine the relationships between the socioecological factors and the main outcome variables.

**Results:** Mean occupational sitting time was 435 (SD = 113) minutes per day, equalling 81% of work time. The majority of the sample experienced more sitting (78%) and less standing (68%) and moving (79%) during work time under the COVID-19 homeworking regulations. Home offices were primarily equipped for seated work, and the work situation seemed to discourage OSB reduction. No evidence for relationships between socioecological factors and OSB was found. Perceived difficulty to reduce OSB at home compared to at work, lack of information on sedentary breaks, and fewer work breaks were significant predictors for the experienced increase in OSB.

**Conclusion:** This study shows that home office workers were highly sedentary and experienced more occupational sitting. Moreover, it indicates but could not provide evidence for actual (significant) increase in OSB since the homeworking regulations. Potential strategies for reducing OSB at home are adding or creating standing workspaces, and providing information on and habitualising breaks in work time and in sitting during work time.


**Keywords**: Occupational sedentary behaviour, sitting, office workers, working from home, teleworking, home office, workplace, socioecological, COVID-19 regulations, relationship testing.

[1] Alternatively, see Appendix A for the management summary of this study.

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# 1 Introduction

It is common to sit a lot during the day, especially for white-collar workers. Too much prolonged sitting is linked to deleterious health effects. Consequently, interventions have been developed, for example to reduce work time sitting in offices. Offices are appropriate for these interventions due to being the sociocultural and physical settings for this individual behaviour. As part of the responses to the COVID-19 pandemic, many office workers had to work from home. So far, little is known about the factors influencing sitting, or sedentary behaviour, in people working from home. Therefore, this study aimed to report how much employees sat while working primarily from home, as well as report on related factors influencing sitting while working from home.

## 1.1 Sedentary Behaviour

Due to sociotechnological developments over the past century, demands for physical activity have been significantly reduced, while sedentary behaviour levels have increased (Owen et al., 2010). Sedentary behaviour (SB) is any waking behaviour characterised by an energy expenditure ≤1.5 metabolic equivalents while in a sitting, reclining or lying posture (Barnes et al., 2012). Typical behaviours include watching television, computer use, and sitting during transportation and work time (Owen et al., 2010; Tremblay et al., 2017). Periods of uninterrupted sedentary time (sedentary bouts) are separated by sedentary breaks (i.e. significant changes in posture, such as standing up or going for a walk; Tremblay et al., 2017). SB is distinct from a lack of physical activity (PA), as someone can be sufficiently active according to national PA guidelines while sitting too much, for example during work time (Bakker et al., 2020; Tremblay et al., 2017). This distinction is important for health promotion purposes.

SB is associated with detrimental health effects. These include premature all-cause mortality, cancer, and chronic illnesses such as metabolic syndrome, cardiovascular disease and type 2 diabetes mellitus (Ku et al., 2018; Patterson et al., 2018; Rezende et al., 2014), as well as low back pain disability and intensity (Alzahrani et al., 2019; Hussain et al., 2016). These health effects were found independent from PA, with stronger associations between greater health risk and more SB (>6 hours; Patterson et al., 2018). New research controlling for different PA levels showed that higher volumes of moderate to vigorous physical activity (MVPA) can attenuate deleterious health effects of SB (Biddle et al., 2019; Ekelund et al., 2016; cf. Stamatakis et al., 2019). Nevertheless, these levels of MVPA were quite high and not met by 75% of the population (Ekelund et al., 2016), reflecting the plausible risk of SB as increased risk for higher levels of mortality (Biddle et al., 2019). Ergo, both PA promotion *and* SB reduction remain important.

The prevalence of SB in the Netherlands is high. As measured in 2017 by Dutch Statistics (*Centraal Bureau voor de Statistiek* [CBS]) and the Dutch National Institute for Public Health and Environment (*Rijksinstituut voor Volksgezondheid en Milieu* [RIVM]), citizens (≥4 years old) sat on average

9.4 hours/weekday, 2.5 hours of which was at work (RIVM, n.d.). However, levels of SB differ between sociodemographic groups, such as by occupation. For example, office workers tend to sit more than labourers (Kazi et al., 2019; Prince et al., 2019). In a study for the European Union (EU), students (17%), managers (17%) and other white-collar workers (19%) reported spending over 8.5 hours/day seated. Overall for EU nations, this was 12% of all respondents, against 32% of all Dutch respondents (Special Eurobarometer 472, 2018). Regarding a possible attenuation by MVPA, 49% of adults were physically active according to the Dutch exercise guidelines in 2019 (CBS, 2020). Another Dutch study reported high sedentary levels (9.1 hours/weekday) in a sample where 86% of participants met the nationally recommended PA levels (Bakker et al., 2020). Therefore, even when active, Dutch people sit too much.

SB is likely influenced in various ways. Ecological frameworks help to conceptually understand how health behaviours such as SB are influenced via multiple factors across several levels of influence, including individual, interpersonal, environmental, cultural and policy levels (McLeroy et al., 1988). Owen and colleagues (2011) proposed a socioecological model (see Figure B1 in Appendix B) accounting for different domains in which SB takes place, namely leisure time, transportation, domestic or occupational. These domains provide their own contexts in which individuals engage in SB (Owen et al., 2011). Accordingly, SB reduction interventions may need to focus on particular settings, such as the workplace. Most adult people spend the majority of their waking time working, meaning that *occupational sedentary behaviour* (OSB) is a public health problem. Office workers may spend more than two-thirds of their work time seated; over half of which in prolonged bouts (≥30 minutes) with little PA (Hadgraft, Healy, et al., 2016; Kazi et al., 2019; Parry & Straker, 2013). Interventions in OSB therefore are important for public health. So far, interventions in and studies of factors related to OSB have logically taken place in usual workplaces. Meanwhile, teleworking becomes more popular. In 2019, 5% of employed persons in the EU and 14% of those in the Netherlands usually worked from home (Eurostat, 2020). Moreover, most countries have issued a lockdown or similar regulations as part of the response to the COVID-19 pandemic, enforcing employees to work from home where possible. Consequently, *OSB at home* emerges as a health concern.

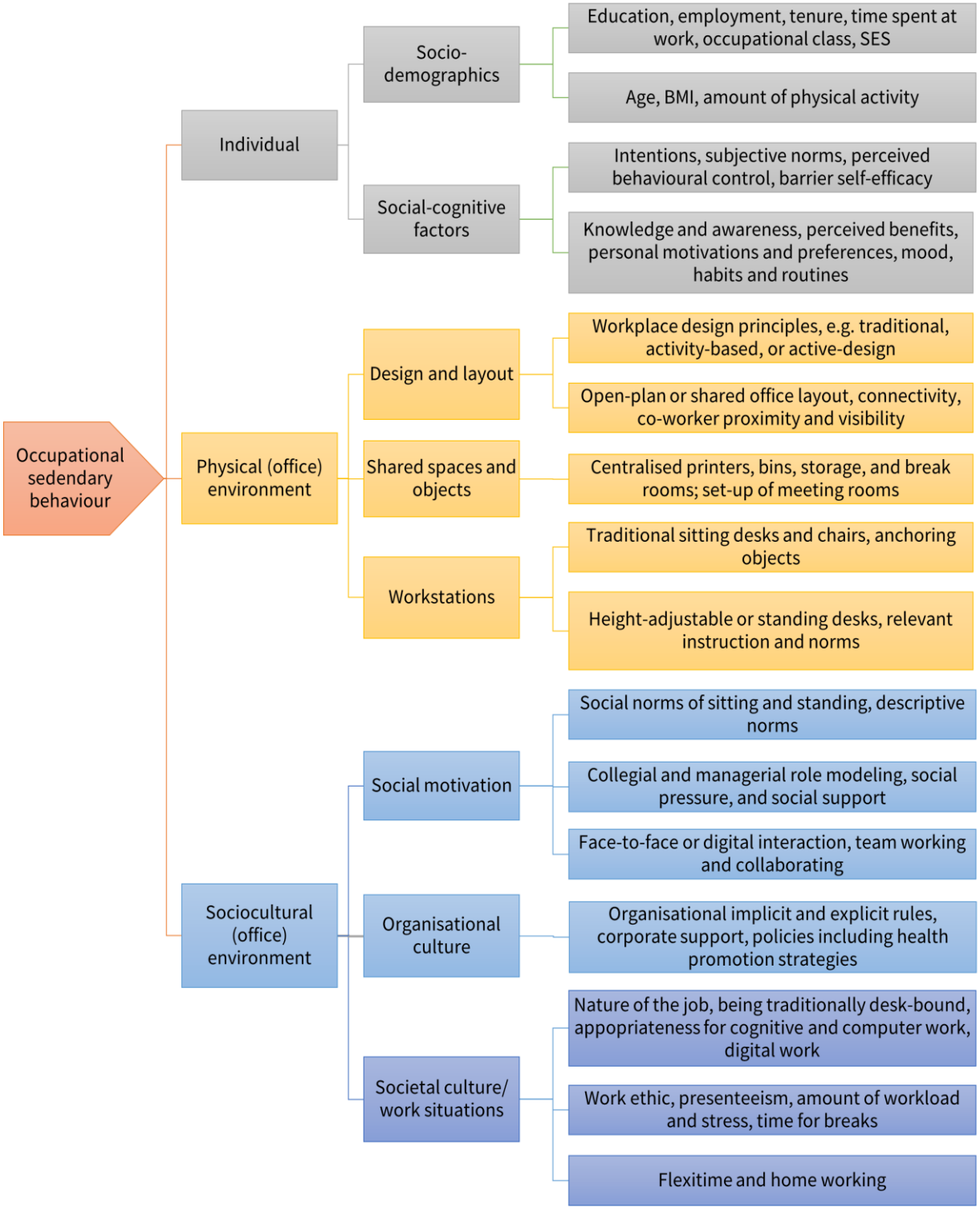
### 1.2 Socioecological Model of OSB

Socioecological influences in OSB in office workers can be distinguished between individual aspects, physical and sociocultural office environments, and work situations, as depicted in Figure 1. This section will scope out factors related to OSB in offices using the socioecological framework. Although the primary purpose of this overview is identifying possible factors that can be used by OSB reduction interventions, not all factors are modifiable and are therefore less beneficial to be targeted (Biddle, 2018; Owen et al., 2011). However, non-modifiable factors provide information on contexts in which

interventions can work. The subsequent section reflects on how socioecological factors may change due to the COVID-19 homeworking regulations and how this might influence OSB at home.

**Figure 1**

*Factors According to Socioecological Levels of Occupational Sedentary Behaviour in Typical Office Work*




*Note.* Abbreviations: BMI = body-mass index; SES = socioeconomic status. This overview is based on an unpublished review by this author.

### *1.2.1 Individual Factors in OSB*

On an individual level, multiple sociodemographic factors were found to interact with OSB. Positive relationships of higher OSB levels have been found with higher education, higher occupational class or having a white-collar job, higher household socioeconomic status, spending more time at work, and having shorter tenure (Bakker et al., 2020; Bernaards et al., 2016; Busschaert et al., 2016; Hadgraft, Healy, et al., 2016; Hadgraft et al., 2015; Nicolson et al., 2019; Prince et al., 2017; Saidj et al., 2015; Wilkerson et al., 2018). Furthermore, higher levels of OSB were associated with being of younger age, having higher body-mass index and being less physically active (Bakker et al., 2020; Bernaards et al., 2016; Hadgraft, Brakenridge, et al., 2016; Nicolson et al., 2019; Saidj et al., 2015). In short, high levels of OSB are often found in traditionally sedentary jobs and in less active people.

Additionally, many social-cognitive factors have been observed. When applying the Theory of Planned Behaviour (Ajzen, 1985) to OSB, associations were found with the constructs intention, perceived behavioural control and subjective norms (Prapavessis et al., 2015; Prince et al., 2017), with attitude mediating sitting time through intention (Prapavessis et al., 2015). Furthermore, higher barrier self-efficacy (i.e. the perceived ability to overcome barriers to reducing work time sitting) is related to less sitting time (Wilkerson et al., 2018). Although no direct associations between attitude and OSB have been found, OSB is influenced by perceived benefits of sitting, and knowledge and awareness of OSB and its health effects, including knowing of the distinction between PA and SB (Ojo et al., 2019; Prince et al., 2017; Wang et al., 2019). More obviously, personal motivation and preferences about sitting and breaking OSB matter as well. Work time sitting is increased by, for example, experiencing more comfort when sitting than when standing, preferring PA after work, not feeling motivated to reduce OSB, or finding it convenient to stay seated during work (Flint et al., 2017; Mackenzie et al., 2019; Morris et al., 2018; Ojo et al., 2019). Finally, OSB is a matter of automatic, nonconscious routines and habits, such as usually sitting behind the computer (Flint et al., 2017; Mackenzie et al., 2019; Ojo et al., 2019; Smith et al., 2018; Wang et al., 2019). To conclude, a lot of information about the individual factors of typical OSB is known. These factors are bound to physical and sociocultural contexts.

### *1.2.2 Physical Factors of Office Environments in OSB*

Many physical aspects of the workplace are found to influence OSB. First, multiple studies found that workplace designs principles can encourage more PA and less OSB (Candido et al., 2019; Engelen et al., 2017; Hallman et al., 2018; Jancey et al., 2016; Wallmann-Sperlich et al., 2019). Similarly, prolonged sitting is influenced by having private, shared, or open workspaces (Duncan et al., 2015; Mullane et al., 2017), via the availability of possible routes (Duncan et al., 2015; Engelen et al., 2017; Wilkerson et al., 2018), and through proximity to and visibility of co-workers (Duncan et al., 2015). Additionally, centralised facilities, such as printers, bins, storages, and break rooms, can be used as opportunities to

break OSB (Brakenridge, Healy, Winkler, et al., 2018; Candido et al., 2019; Flint et al., 2017; Hadgraft et al., 2017; Jancey et al., 2016; Loffler et al., 2015). In contrast, meeting rooms traditionally are set up for sitting, and mostly used thusly (Loffler et al., 2015; Mackenzie et al., 2019). In summary, how workplaces are set up influences how much one sits.

Individual workstations can similarly influence OSB. Traditional desks invite people to work seated (Hadgraft, Brakenridge, et al., 2016; Loffler et al., 2015). This is at least partly caused by computers and telephones or headsets obstructing or prohibiting employees to stand or move (Mackenzie et al., 2019; Morris et al., 2018; Ojo et al., 2019; Such & Mutrie, 2017; Sugiyama et al., 2019). Height-adjustable desks (HAD) are often necessary in order to work while standing, but have their own challenges. They are often not used because of ergonomic issues, non-practicality and inconvenience (Hadgraft, Brakenridge, et al., 2016; Mackenzie et al., 2019) or are simply not available to employees (Hadgraft, Brakenridge, et al., 2016; Hadgraft et al., 2017; Morris et al., 2018; Wang et al., 2019). Additionally, HAD can cause employees to feel, literally and figuratively, to 'stand out', which can be perceived as disruptive and awkward in open-plan offices (Mackenzie et al., 2019; Ojo et al., 2019). In contrast, using HAD can also help normalising standing in the office (Hadgraft et al., 2017). Finally, HAD may be underused due to employees not knowing why and how to use them (Chau et al., 2016). Incorrect use can lead to poor posture and musculoskeletal issues, resulting in employees to fall back to more OSB (Hadgraft, Brakenridge, et al., 2016; Morris et al., 2018). Thus, office workspaces usually are designed for sitting and sitting alternatives are scarcely used. The physical environment is tied to sociocultural customs.

#### *1.2.3 Social Factors of Office Environments in OSB*

Occupational sitting is influenced by social norms and other social influences, organisational cultures, and broader societal culture. In many workplaces, standing up or moving around outside of purposeful breaks is seen as counternormative, unusual or weird (Hadgraft, Brakenridge, et al., 2016; Mackenzie et al., 2019; Such & Mutrie, 2017; Wang et al., 2019). However, work time sitting can be reduced by collegial (Hadgraft, Brakenridge, et al., 2016) or managerial role modelling (Brakenridge et al., 2016; Brakenridge, Healy, Hadgraft, et al., 2018; Morris et al., 2018). Nevertheless, co-workers and managers can also be exemplary in promoting occupational sitting, such as by skipping breaks and eating at one's desk, which is often seen as a barrier towards reducing OSB (Morris et al., 2018; Such & Mutrie, 2017; Wang et al., 2019). Social pressure can be exerted both directly and subliminally, and both promotive of and discouraging OSB (Cole et al., 2015; Flint et al., 2017; Ojo et al., 2019). Furthermore, collegial and managerial social support in reducing OSB entails leniency towards moving from one's desk, taking breaks, being physically active, and using each other as prompts or reminders to stand up from or during work (Brakenridge, Healy, Hadgraft, et al., 2018; Brakenridge, Healy, Winkler, et al., 2018; Chau

et al., 2016; Cole et al., 2015; Hadgraft et al., 2017; Mackenzie et al., 2019; Such & Mutrie, 2017). Conversely, fear of being judged by colleagues for taking breaks or due to interdependence of work efforts can be a negative influence (Cole et al., 2015; Ojo et al., 2019). Finally, interacting face-to-face rather than digitally facilitates OSB reduction (Loffler et al., 2015; Mullane et al., 2017; Such & Mutrie, 2017). In short, social motivation is important for challenging and promoting OSB.

On a higher level of influence, organisational (implicit) rules, practices, and policies can influence OSB as well. Not every organisation is supportive of OSB reduction, for instance seeing work time as 'chargeable time' where employees should stay at their desks, even during breaks (Flint et al., 2017; Such & Mutrie, 2017). Similarly, in many organisations, there is managerial disapproval of sedentary breaks, an organisational preference of e-mails over face-to-face communication, lack of corporate role modelling, and simply no challenging of OSB norms (Morris et al., 2018; Such & Mutrie, 2017). A lack of interest in OSB reduction is also shown in the underrepresentation of OSB in corporate policies and strategic documents, including health promotion policies (Cole et al., 2015; Flint et al., 2017; Hadgraft, Brakenridge, et al., 2016; Mackenzie et al., 2019; Morris et al., 2018). Moreover, occupational PA and SB strategies are often discussed in terms of short-term health and safety – specifically about repetitive strain and musculoskeletal health problems – without acknowledging OSB as a health concern in itself (Such & Mutrie, 2017). These organisational influences are themselves influenced by broader cultural aspects.

#### *1.2.4 Factors Related to Work Situations in OSB*

Societal, economic, and political notions of work affect OSB. Occupational sitting is often considered as part of the nature of the job (Cole et al., 2015; Flint et al., 2017; Loffler et al., 2015; Mackenzie et al., 2019; Such & Mutrie, 2017; Wang et al., 2019). Specifically, sitting is deemed appropriate for cognitive tasks and work performance, and for work with computers (Cole et al., 2015; Hadgraft et al., 2017; Loffler et al., 2015; Mackenzie et al., 2019; Such & Mutrie, 2017; Wang et al., 2019). In fact, technologies direct workers towards digital work, replacing physical storage and face-to-face interaction and leaving people tied to their desks (Hadgraft, Brakenridge, et al., 2016; Such & Mutrie, 2017). Similarly, beliefs that one must be seen sitting at their desk to be working impedes employees' ability to break sedentary bouts (Cole et al., 2015; Mackenzie et al., 2019). In terms of work ethic, employees hold themselves accountable for the work that needs to be done (Such & Mutrie, 2017; Wang et al., 2019). Moreover, heavy workload and stress promote OSB (Cole et al., 2015; Kurita et al., 2019; Mackenzie et al., 2019; Such & Mutrie, 2017; Wang et al., 2019). Many employees (perceive to) have too little time to break OSB or lose track of time while working (Hadgraft, Brakenridge, et al., 2016; Kurita et al., 2019; Ojo et al., 2019; Such & Mutrie, 2017). In brief, culturally informed aspects of work and work ethic, including workload and stress, are often barriers to reducing OSB at work.

Working from home and flexitime working would give workers the ability to work without scrutinization by colleagues and management. Therefore, it should give employees the flexibility and convenience to reduce OSB as well (Mackenzie et al., 2019). However, Olsen and colleagues (2018) found that flexible work policies were associated with more OSB. Possibly, employees worked and accordingly sat more to do less at home (Mackenzie et al., 2019; Olsen et al., 2018). Additionally, workers may find fewer reasons to sit less or may feel as being perceived as working less hard, which makes them work less often from home or work longer and harder (Mackenzie et al., 2019). However, these studies reported on homeworking as *alternative* to working at work, where the latter was still the norm (e.g. teleworking only one day a week). These studies therefore do probably not reflect the mandatory homeworking regulations situation. Working from home may drastically change the physical and sociocultural contexts that facilitate or impede OSB. The next section reflects on possible factors related to OSB at home.

### 1.3 Changes in Socioecological Factors Related to OSB due to COVID-19 Regulations

Consequences of the COVID-19 homeworking regulations may cause occupational sitting time to increase. So far, no studies have been conducted to support this perspective, but it can be argued based on an expected increase in barriers to and loss of enablers for reducing work time sitting. On the individual level, while sociodemographic factors may not have changed, [2] social-cognitive factors may have shifted. Workers may think of OSB as less important at the moment, thus being less interested in the detrimental health effects of OSB and the health benefits of reducing prolonged sitting time. Additionally, habits and routines related to work time sitting are complex, as they relate to environmental circumstances. While most employees lose PA habits, such as taking the stairs over the lift or walking towards colleagues instead of emailing them, it is difficult to predict if people keep or adopt sedentary habits (e.g. eating at the desk). Similarly, people may take up sedentary habits of leisure time or other behaviour in the domestic setting or, conversely, make more time to exercise during work hours. Finally, workers may perceive to have more control over their work time sitting or standing behaviour, by having more actual control over the workplace and less or no social scrutiny. Changes in individual aspects of OSB can be difficult to study, but may lead to an increase of OSB.

When at home, many enablers to reduce work time sitting and barriers towards OSB have been removed, while enablers of OSB are increased. First of all, many employees will not have the right equipment to work from home, let alone possess furniture that allows them to reduce work time sitting. Few people have HAD at home as they are expensive and nonnormative, making it difficult to work

[2] That is, in regard to occupational SB. For example, loss of employment and subsequent changes in SES may be linked to an increase in leisure/domestic SB, substituting, however, occupational SB.

while standing. Organisational and employees' priorities towards workspace furniture may first be to have ergonomic office chairs and appropriate desks – not necessarily HAD. Moreover, employees may not even have dedicated places to work from, which can directly or indirectly increase work time sitting. For example, it may be harder to work effectively in the living room, increasing work time and consequently OSB. Furthermore, people may lack opportunities to break sitting time. Reasons or excuses (including the aforementioned habits and routines) used in workplaces to reduce OSB, such as interaction with other employees or shared facilities, are no longer available. One new possible enabler are co-habitants, such as partners who try to be more physically active during working hours, children to keep busy, or pets persuading to go for a walk. As social influences, co-habitants might appeal to reduce sitting time, while perceived negative social norms towards work time standing or walking may disappear. However, the same applies for positive role modelling and social support regarding breaks in work time sitting. Considering these built and social contexts, it seems plausible that employees tend to sit more while working from home.

Finally, work aspects may not support or can directly interfere in OSB reduction. While the homeworking regulations did not directly change the nature of people's jobs, it changed for many how they are able to do their work. For example, tasks may take longer and workload may have increased, leading to longer working days and more sitting time. Moreover, it is unclear if employees find time and motivation to break sedentary time. While perceived pressure to stay at one's desk may dissipate without direct visibility of co-workers and supervisors, notions to finish one's job may stay or even get stronger than ever, as found previously (Mackenzie et al., 2019). This coercion may change over time as, for example, workload becomes easier, resulting in more time to take sedentary breaks. However, less OSB and more occupational standing may require available alternative means to work, such as HAD or other standing equipment. In short, while some new possibilities to reduce OSB were introduced with the COVID-19 homeworking regulations, many barriers remained or were added. While it seems plausible to assume that work time sitting is increased, a study reflecting on these factors is necessary to determine this.

### 1.4 The Current Study

With the start of the Dutch COVID-19 regulations in March 2020, many aspects of life changed, including those related to work. As discussed, factors related to OSB are expected to have changed as well. However, so far, no studies on possible factors of home office environments or homeworking situations related to OSB at home have been conducted. Moreover, as of yet there is no information available on how much employees sit while working primarily from home. As working from home becomes part of the 'new normal' for office workers – that is, continues to be the norm during the COVID-19 regulations or stays more common after those – insights into OSB at home and related factors

are necessary to develop strategies to reduce OSB at home. Therefore, this opportunistic, exploratory study consisted of a cross-sectional survey scoping out how much OSB home office workers showed and describing characteristics of and hypothesised socioecological factors in the home office. Additionally, experienced changes in work aspects related to OSB were examined. Finally, possible factors associated with an experienced change in OSB since the homeworking regulations were explored. Consequently, the main research questions of this study were:

1. How much OSB is reported by employees while working from home?
2. What are the characteristics of home office environments?
3. Which socioecological factors related to OSB are found in home office environments?
4. Which changes associated with working from home relevant to OSB do people experience?
5. What are the relationships between socioecological factors of working in home office environments and self-reported occupational sitting time at home?
6. What are the relationships between socioecological factors of working in home office environments and experienced change in OSB?

# 2 Methods

## 2.1 Study Design, Participants and Procedure

For this cross-sectional study, a questionnaire was distributed via the Qualtrics online survey tool, which was open from end-June to mid-August 2020. This study was approved by the Ethics Committee of the University of Twente (request number 200843). Participants were employees of a Dutch university, which had no prior organisation-wide interventions in OSB. Primary recruitment occurred via convenience sampling. Employees received an invitation via the faculty organisation and via an associated news medium. Additionally, snowball sampling was used: employees were directly approached to participate in and further distribute the survey. Inclusion criteria were that participants: a) were 18 years or older; b) sufficiently understood English; c) worked from home at the time of participating; and d) had traditionally sedentary work (i.e. were part of academic staff, PhD candidates, or supporting or management staff). This last criterium excluded janitorial staff and security staff.

Employees were informed about the research aims and actively gave informed consent before participation (see Appendix C). Next, the survey consisted of quantitative measures discussed below and additional open questions used in an accompanying qualitative study. After omitting participants not reporting on the main study outcomes, the sample consisted of 119 valid cases. 113 participants (95%) completed the entire survey. The other six, ranging from 42% to 81% completion, at least reported on the main study outcomes.

## 2.2 Measures

The survey was created using items from or inspired by previous studies, most of which formed validated scales. These included socioecological factors hypothesised to affect OSB (Hadgraft, Brakenridge, et al., 2016; Wilkerson et al., 2018) or sedentary breaks (Kurita et al., 2019). However, these scales were modified to fit the homeworking situation, for instance by excluding items on transportation or co-worker visibility. Factor analyses and internal consistency measures were conducted to determine usability of scales or potential subscales. In addition to these socioecological variables, the survey included sociodemographic items, measures of OSB, and items on characteristics of the home office and changes in work aspects. The entire questionnaire can be found in Appendix D.

### *2.2.1 Sociodemographic and Work-Related Factors*

Participants reported their age, gender, and highest completed level of education. Next, work-related items assessed employment classification (*PhD students, academic staff*, or *support and management staff*), appointed number of working hours per week, office type at the university (*private, shared,* or *other*), and homeworking frequency before the COVID-19 regulations. Finally, employees were asked if they were physically able to stand for at least 15 uninterrupted minutes.

### *2.2.2 Sedentary Behaviour*

OSB was measured via self-reports for pragmatic reasons. Objective measurement instruments such as the ActivPAL and ActiGRAPH are more reliable, as people tend to underestimate how much they sit and stand, and overestimate how much they walk (see e.g. Maes et al., 2020). However, these instruments require more resources, both in instruments and in application of these instruments, which was not possible at the time of this study (i.e. not being physically at the same location). Moreover, self-report assessments allow for easier access to more participants, as they are less intrusive and can be taken at any time and place.

To counteract the aforementioned problems with self-report measurements, an adapted version of the Brief Questionnaire on Occupational Sitting (BQOS) was used. The BQOS was developed, originally composed in Dutch, by Van de Lagemaat (2018). However, the current adaptation was translated into English. The questionnaire asked participants for activity patterns, that is, for points in time and time spans, related to the working day via multiple items. For example, participants were asked what time they wake up, go to or start work, end work, and go to bed. Additionally, they were asked to think about for how long they sit between those moments. An example item is "*How much time do you spend sitting between the moment of starting and stopping to work? (Think of working at your desk, during breaks, meetings, etc.)*", which was to be answered in both hours and minutes. This way, participants were nudged to actively think about their sitting behaviour. This adaptation focused on

homeworking by excluding items on sitting during transportation and by slightly rephrased sentences. Another English version of the BQOS showed good test-retest reliability and is supposed to be valid, although was tested with a student population rather than a full-time employee population for which the original version and the current adaptation were created (Wißmann, 2019). It has yet to be fully tested for criterion validity using objective instruments, but similar multi-item self-report instruments perform relatively well (Prince et al., 2020).

#### *2.2.3 Characteristics of the Home Office Environment*

Characteristics of the home office environments were assessed via seven items. Participants were asked about their usual workplace (*dedicated office/study room; kitchen/dining room; dedicated workspace in living room; same space as for leisure in living room; main bedroom; other*), and about their types of desk (*sitting desk/table/equivalent; sit/stand desk; standing desk/table/equivalent; other*) and sitting furniture (*office chair; dining chair; living room/comfortable chair; couch; alternative furniture (e.g. sitting ball or knee chair); none (mostly standing); other*). Satisfaction with each furniture type was measured via a five-point Likert scale (1 = *not at all* and 5 = *very much*). Two items assessed how often the participant used alternative sitting furniture a) at their usual place of work and b) in their home office. Furthermore, participants were asked about the number of co-habitants, separated by adults, children, and pets, and about how often they shared their workspace with others via a five-point Likert scale (1 = *never* and 5 = *always*).

#### *2.2.4 Social-Cognitive Factors related to OSB*

Perceived behavioural control of OSB and attitudes regarding health effects from occupational sitting were assessed via five items. The extend of control employees perceived towards sitting or standing while working at their desk was assessed via one item. Additionally, four items assessed attitudes on how sitting while working from home relates to health. These items were previously described as '*knowledge'* (Hadgraft, Healy, et al., 2016), but were more similar to items assessing instrumental aspects of attitudes towards OSB in other studies (Meyer et al., 2016; Prapavessis et al., 2015). Internal consistency between the items was found to be poor in both the original (Cronbach's $\alpha$ = .50; Hadgraft, Healy, et al., 2016) and this study (Cronbach's $\alpha$ = .45). Factor analysis (see Appendix E for the statistics) showed two factors suggesting subscales. The first consisted of two items on the benefits of being active during work. This proved to have adequate internal consistency (Cronbach's $\alpha$ = .67; Pearson's $r(111)$ = .52, $p < .001$) and was compiled as the subscale '*Perceived benefits of being active during work time*'. The second factor, regarding *personal control*, had poor internal consistency: Cronbach's $\alpha$ = .27; Pearson's $r(111)$ = .16, $p$ = .086. Consequently, the remaining two variables, pertaining perceived health consequences of prolonged sitting and belief in attenuation by exercise, were analysed separately. All items were measured on a five-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*).

#### *2.2.5 Perceived Ability to Reduce OSB in the Home Office*

Seven items were used to assess how employees perceived their ability to work while standing or otherwise reduce occupational sitting in their workspace. A factor analysis (see Appendix F for the related statistics) suggested three items forming a subscale of '*ability to work while standing*' with good internal consistency: Cronbach's $\alpha$ = .86. An additional item on standing while talking on the phone loaded on the same factor, but had a below .3 communality in the factor and significantly decreased internal consistency, and was therefore left out of the subscale. An example item is '*In my current workspace, I am able to use my PC while standing*'. Next, two items addressed hindrance from physical aspects and comparison to the usual (organisational) working place. Finally, two items assessed the possibility of using facilities (getting coffee or tea; using the printer) as a sedentary break, that is, requiring to walk more than 5 meters. These items were all measured on a five-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*).

#### *2.2.6 Social Influences on OSB While Working From Home*

Organisational support and role modelling on OSB reduction were assessed via six statements on five-point Likert scales (1 = *strongly disagree* and 5 = *strongly agree*). Two items asked participants on perceived organisational support and received information from the organisation on how to reduce sitting while working from home. Additionally, four items inspired by a previous study (Hadgraft, Healy, et al., 2016) assessed a) social support and b) role modelling by managers and colleagues. Internal consistency in all six items proved to be good (Cronbach's $\alpha$ = .89), resulting in the subscale '*organisational influences'*. An example statement is '*My colleagues are an example to me for reducing sitting time while working from home*'. Similarly, social support and role modelling from co-habitants was measured on a five-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree)*, with an additional *non applicable* answer option. This resulted in the subscale '*social influences from co-habitants*', with good internal consistency: Cronbach's $\alpha$ = .78; Pearson's $r(96) = .64$, $p < .001$. The statistics regarding the factor analysis suggesting the subscales can be found in Appendix G.

Finally, two items measured social influences in the home office environment on the participant's perceived ability to reduce work time sitting. Along the seven other items regarding perceived ability (see 2.2.5), a factor analysis (see Appendix F) yielded a factor with modest internal consistency: Cronbach's $\alpha$ = .62; Pearson's $r(112) = .46$, $p < .001$. This resulted in the subscale '*social influences on sitting in the home office'*.

#### *2.2.7 Factors Related to Sedentary Breaks*

Individual, work-related, and sociocultural factors related to breaking sedentary bouts were assessed using eight statements with a five-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*). inspired

by a previous study (Kurita et al., 2019). A factor analysis suggested three subscales (see Appendix H for the related statistics). The first subscale concerned participants' '*working activity*' interacting with taking sedentary breaks via three items (time, energy, and stress levels regarding taking sedentary breaks), which had good internal consistency after recoding the reverse scored stress item: Cronbach's $\alpha$ = .81. An item regarding the social influence from co-habitants on taking breaks [3] loaded on the same factor, but significantly decreased internal consistency and proved difficult to theoretically substantiate as being related to work activity. The second subscale, regarding '*personal motivation*', proved to have acceptable internal consistency between two items on motivation for breaks and (reverse coded) priority of breaks: Cronbach's $\alpha$ = .70; Pearson's $r(112) = .54$, $p < .001$. The third '*organisational influences*' subscale consisted of two items regarding organisational support and information provision on taking sedentary breaks, but had unacceptable internal consistency (Cronbach's $\alpha$ = .46; Pearson's $r(112) = .30$, $p = .001$). Accordingly, these items were analysed separately in subsequent tests, as was the item on co-habitants.

#### *2.2.8 Changes in and Consequences of Work Aspects due to Working From Home*

Participants reported on experienced changes in work aspects following the homeworking regulations, as well as on experienced consequences of these changes. Possibly changed work aspects were assessed using 12 items with a five-point Likert scale (1 = *much more than usual* and 5 = *much less than usual*). These aspects included: average number of hours per week working; average duration of tasks; quantity of work breaks; workload; distractions from work; communication with colleagues, with management, and with others worked with; satisfaction in work; and sitting, standing, and moving during work time. Factor analysis suggested two possible subscales (see Appendix I). First, a subscale of '*work pressure*' emerged between the two items of workhours and workload with adequate internal consistency: Cronbach's $\alpha$ = .74; Pearson's $r(117) = .59$ $p < .001$. Here, a third item regarding the number of work breaks was kept out, as it significantly decreased internal consistency. Secondly, a subscale of '*communication*' was compiled with modest internal consistency: Cronbach's $\alpha$ = .63.

Next, experienced consequences of changes in work aspects were assessed, using eight statements with a five-point Likert scale (1 = *much better than usual* – 5 = *much worse than usual*). The aspects were: ability to do the job in general; workload; effectiveness of work; communication with colleagues, with management, and with others worked with; physical well-being; and social and mental well-being. Factor analysis (see Appendix J for the statistics) suggested a three-item subscale of

[3] An option for participants to indicate not having co-habitants was mistakenly missing. For subsequent statistical testing, participants without co-habitants were filtered out.

'*communication*', which had good internal consistency: Cronbach's $\alpha$ = .82. A second factor, consisting of all five remaining items loading together, was logically consistent – binding together a relationship between personal well-being with work performance – and proved to have modest internal consistency: Cronbach's $\alpha$ = .69. Consequently, these five items were combined as a subscale of '*well-being and performance*'.

### 2.3 Statistical Analysis

Descriptive statistics of the sociodemographic factors, sedentary variables, and home office characteristics were summarised. Occupational sitting time in minutes, the continuous main outcome variable, was found to violate the assumption of normality. This was determined via visual assessment of a histogram and Q-Q plot (see Figures K1 and K2 in Appendix K), as well as via statistical testing: kurtosis = 3.98, skewness = -1.53, Kolmogorov-Smirnov test: D(118) = 0.15, $p$ < .001. Therefore, nonparametric methods of testing were used. Group differences in sociodemographic characteristics were tested via one-way analysis of variance (ANOVA) – in this case the nonparametric equivalents Mann-Whitney U test or Kruskal-Wallis ANOVA – to determine sample homogeneity. Relationships between potential socioecological factors and a) sitting time in minutes and b) experienced change in OSB were assessed via nonparametric Spearman rank-order correlation analyses. Nonparametric partial correlation analyses were conducted to control for confounding effects caused by group differences in these correlations, while circumventing issues with nonnormal disturbed data. This was done via a method provided by IBM Support (2020), as supported by theory (c.f. Conover, 1999; Schemper, 1991). Subsequently, a multiple linear hierarchical regression analysis was used to determine how much the socioecological correlates could explain the outcomes. To account for the nonparametric data, bootstrapping using the bias-corrected and accelerated bootstrap interval (BCa) method was applied for 95% confidence intervals. An a priori power analysis was conducted via G*Power version 3.1.9.7 to determine sample size required for multiple regression ($\alpha$ = .05, power = .8, effect size = .15, 10 predictors). It yielded a required sample size of 118, which was just above the variable with the lowest number of responses: $n$ = 113. All data were analysed using IBM SPSS version 26; $p$ < .05 was kept for statistical significance.

# 3 Results

## 3.1 Participant Characteristics

### *3.1.1 Sociodemographic and Work-Related Characteristics*

Table 1 presents descriptive characteristics of the study sample ($N$ = 119). Participants were primarily female (78%) and had an academic degree or higher (85%). Mean age was 40.68 years ($SD$ = 11.90, $n$ = 112). Half of the sample (53%) was working as academic staff. The majority of the sample (84%) had a job appointment of at least 32 hours per week. One-tenth (9%) of the sample already worked more than once per week from home before the start of the COVID-19 regulations.

**Table 1**

*Sociodemographic and Work-Related Characteristics*

| Characteristic | *n* | % |
|---|---|---|
| Gender | | |
| Female | 78 | 66 |
| Male | 36 | 30 |
| Other/prefer not to say | 5 | 4 |
| Able to stand for at least 15 minutes | | |
| Yes | 118 | 99 |
| No | 1 | 1 |
| Highest completed education | | |
| Intermediate vocational education (*mbo*) | 6 | 5 |
| Higher professional education (*hbo*) | 12 | 10 |
| Academic education (*wo*) | 55 | 46 |
| Advanced degree (e.g. PhD) | 46 | 39 |
| Employment classification | | |
| Academic staff | 63 | 53 |
| PhD students | 17 | 14 |
| Support and management staff | 39 | 33 |
| Appointed working hours per week | | |
| <32 | 19 | 16 |
| 32 – 35 | 34 | 29 |
| 36 – 39 | 10 | 8 |
| 40 | 56 | 47 |
| Type of office at organisation | | |
| Private | 51 | 43 |
| Shared | 66 | 55 |
| Other[1] | 2 | 2 |
| Previously worked from home | | |
| Always | 4 | 3 |
| Multiple days per week | 7 | 6 |
| Once a week | 36 | 30 |
| Once a month | 18 | 15 |
| Almost never | 26 | 22 |
| Never | 28 | 24 |

Note. n = 119. Abbreviations: *hbo* = *hoger beroepsonderwijs*; *mbo* = *middelbaar beroepsonderwijs*; *wo* = *wetenschappelijk onderwijs* [1] Reported alternatives were: *working at an "office garden"* (cf. open-plan office) and *being appointed during the COVID-19 homeworking regulations*.

### *3.1.2 Self-Reported Sitting Time at Home*

Table 2 summarises daily work and sitting times. While working from home, mean work time was 545 minutes (about nine hours) a day. On average 435 minutes (over seven hours) of this time was spent sitting, equalling a sit-to-work ratio of 81%. With on average 670 minutes (little over 11 hours) of sitting time during waking hours, sitting during work hours corresponded to about 64% of daily sitting time. These outcomes were not exceptional when compared to an earlier study using the BQOS on office workers, which reported a similar sit-to-work ratio of 79.4% (SD = 14.5%; Van de Lagemaat, 2018). Therefore, surprisingly, no deviation in OSB since the homeworking regulations was identified. In brief, the studied sample represented highly sedentary office workers, which was similar to the office worker population.

A Kruskal-Wallis ANOVA revealed a statistically significant difference in occupational sitting by education level: $H(3) = 11.48$, $p = .009$. Participants with higher education levels sat longer: medians of intermediate vocational education = 390 minutes/day (*IQR* = 90.00), of higher professional education = 435 minutes/day (*IQR* = 112.50), of academic education = 450 minutes/day (*IQR* = 120.00), and of an advanced degree = 480 minutes/day (*IQR* = 90.00). No other significant differences by sociodemographic and work-related characteristics were observed. Thus, while the sample was fairly homogeneous, the highest amount of work time sitting was found for highest completed education.

**Table 2**

*Means of Workday and Sitting Time*

| Variable | *M* | *SD* |
|---|---|---|
| Total time awake (mins/day) [1] | 941.93 | 80.06 |
| Total daily sitting time (mins/day) [2] | 670.00 | 134.52 |
| Percentage of sitting time during waking hours [2] | 73.06 | 28.67 |
| Time spent working (mins/day) [2] | 545.09 | 77.82 |
| Sitting during work time (mins/day) [3] | 435.30 | 113.34 |
| Percentage of sitting time during work time [4] | 80.92 | 16.96 |
| Percentage of work-related sitting time of total daily sitting time [2] | 64.43 | 14.43 |

*Note.* [1] $n = 119$; [2] $n = 117$; [3] $n = 118$; [4] $n = 116$.

### *3.1.3 Experienced Change in OSB While Working From Home*

No pre-COVID-19 baseline data on the amount of sitting time in this organisation was available. Therefore, participants were asked if they experienced changes in their activity patterns during work time since working from home. As Table 3 shows, most participants reported to find themselves sitting more (78%) and standing and moving less (68% and 79% respectively) while working from home, as was expected.

**Table 3**

*Frequencies of Experienced Changes in Activity Since COVID-19-Related Working From Home*

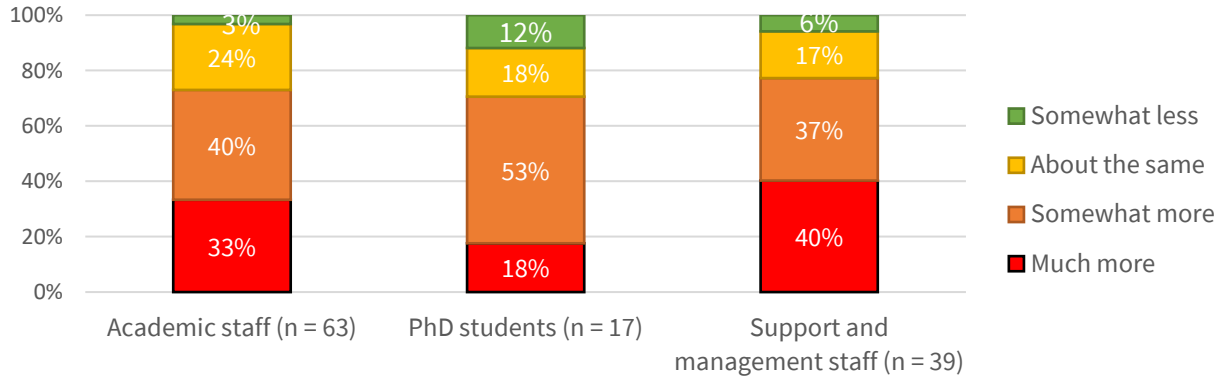
| Experienced changes since COVID-19 related working from home compared to usual | *n* (%) | | | | |
|---|---|---|---|---|---|
| | Much more | Somewhat more | About the same | Somewhat less | Much less |
| In amount of work time sitting | **48 (41%)** | 44 (37%) | 20 (17%) | 7 (5%) | 0 (0%) |
| In amount of work time standing | 0 (0%) | 6 (4%) | 33 (28%) | **46 (39%)** | 34 (29%) |
| In amount of work time moving | 2 (2%) | 8 (7%) | 14 (12%) | 41 (34%) | **54 (45%)** |

*Note*. $n = 119$; variables are measured on a scale of 1 – 5; Boldface denotes the most frequent response.

A Kruskal-Wallis ANOVA revealed a statistically significant difference in experienced change in OSB by employment classification: $H(2) = 9.971$, $p = .007$, indicating a greater perceived change in amount of sitting for management and support staff than for academic staff and PhD students. Figure 2 depicts these distributions. No other significant differences by sociodemographic and work-related characteristics were observed. In summary, participants were highly sedentary during workhours. Most employees experienced an increase in occupational sitting time and a decrease in physical activity during workhours. Group differences were observed by education for occupational sitting time and by employment type for experienced change in OSB.

**Figure 2**

*Frequencies of Experienced Change in Occupational Sitting per Employment Classification*




## 3.2 Characteristics of the Home Office Environment

Table 4 provides the characteristics of the home offices. While the majority of the sample (90%) had at least one co-habitant, most (66%) did not share their workspace. Participants worked primarily in a dedicated workspace (65%), behind a sitting desk or table (93%), while sitting on an office or dining chair (92%). Satisfaction with workspace furniture was mixed. The majority of the sample was at least somewhat satisfied with their desk (57%, $n = 67$) as well as with their seat (60%, $n = 71$), although there

was more dissatisfaction ($n$ = 18) than satisfaction ($n$ = 15) with dining chairs. Viewed from the perspective that many employees did not have home offices equipped for full-time work before the COVID-19 regulations, these numbers were considered to be fairly positive, although sub-standard compared to normal office environments and for long-term homeworking.

**Table 4**

*Characteristics of the Home Office Environment*

| Characteristic | *n* | % |
|---|---|---|
| Having one or more co-habitants | | |
| Adults | 99 | 84 |
| Children | 49 | 42 |
| Pets | 42 | 36 |
| Any | 106 | 90 |
| Frequency of time sharing workspace with co-habitants [1] | | |
| Always | 4 | 4 |
| Most of the time | 7 | 7 |
| About half the time | 11 | 10 |
| Sometimes | 14 | 13 |
| Never | 70 | 66 |
| Most frequent place of work | | |
| (Temporarily) dedicated office or study room | 67 | 57 |
| Kitchen or dining room | 16 | 14 |
| Dedicated workplace in living room | 10 | 8 |
| Living room (same place as for leisure) | 16 | 14 |
| Main bedroom | 4 | 3 |
| Other [2] | 5 | 4 |
| Most frequently used type of desk | | |
| Sitting desk or table | 110 | 93 |
| Sit/stand desk | 4 | 3 |
| Standing desk or table | 1 | 1 |
| Other [3] | 3 | 3 |
| Most frequently used type of seat | | |
| Office chair | 72 | 61 |
| Dining chair | 37 | 31 |
| Living room chair or lounge chair | 1 | 1 |
| Couch | 2 | 2 |
| Alternative furniture (e.g. sitting ball or knee chair) | 1 | 1 |
| Other [4] | 5 | 4 |
| Use of alternative sitting facilities in home office | | |
| Daily or almost daily | 8 | 7 |
| Once or twice a week | 7 | 6 |
| Once or twice a month | 3 | 2 |
| A few times a year | 1 | 1 |
| Never | 99 | 84 |

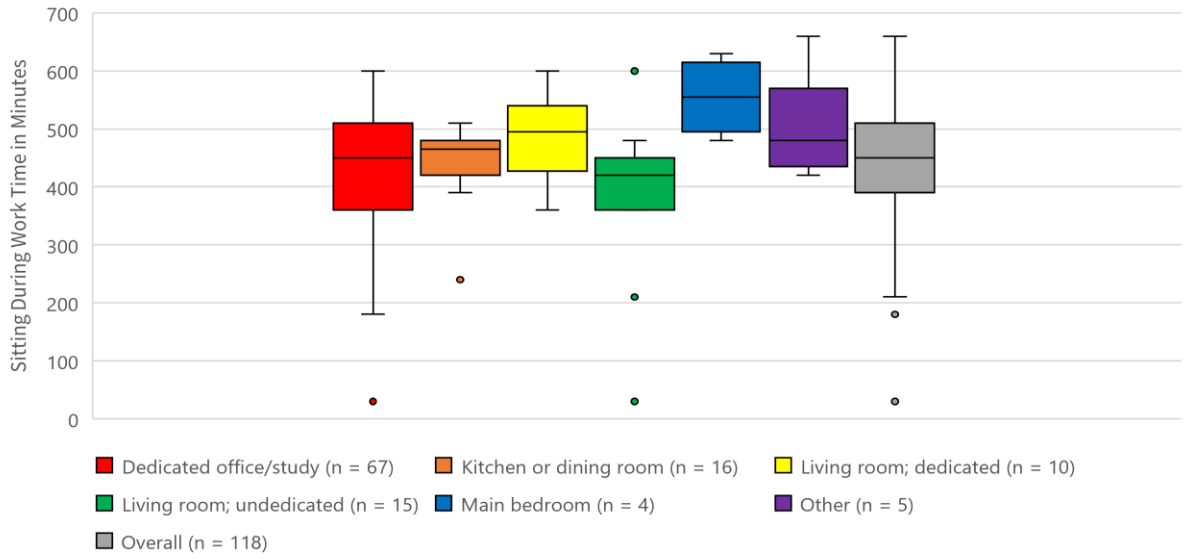
*Note*. $n$ = 118; [1] Only participants with at least one co-habitant are reported; $n$ = 106. [2] Reported workspace alternatives were: *frequently switching between places, consisting of combined features, attic,* and *atelier*. [3] Desk alternatives reported were: *varying places* or *none* (*sofa; laptop resting on the legs*). [4] Seating alternatives reported were: *switching between different types, saddle chair, stool,* and *wicker chair*.

Alternative sitting facilities, including HAD, were little utilised. When working from the usual workplace at the organisation, one-fifth of the sample used sitting alternatives at least sometimes (22%, $n = 26$), with only six participants (5%) using them daily. Eight participants reported other methods to reduce sitting, for instance taking breaks, going for a walk or using software prompts to reduce sitting. Some participants commented HAD were not available to them at the organisation. When working from home, the majority of the sample (84%, see Table 4) never used sitting facilities. Possibly, this was because participants did not possess such furniture.

For self-reported occupational sitting, a statistically significant difference across workspaces was found through a Kruskal-Wallis ANOVA: $H(5) = 13.93$, $p = .016$. Employees working from a non-dedicated workplace in the living room sat the least ($Mdn = 420$ minutes, $IQR = 90$), while those working from the main bedroom sat the most ($Mdn = 555$ minutes, $IQR = 120$; see Figure 3 for the distribution of all groups). However, it should be noted that these groups were relatively small. Additionally, a Mann-Whitney U test revealed that employees with any co-habitants experienced a little less change in sitting time ($Mdn$ = *somewhat more than usual*, $IQR = 2$, $n = 106$) than employees without co-habitants ($Mdn$ = *much more than usual*, $IQR = 1$, $n = 12$): $U = 346.50$, $p = .006$. However, the substantial differences in group sizes makes comparison difficult. No other significant differences for home office characteristics were observed. In summary, most participants had a private home workspace and used sitting furniture not allowing to reduce sitting time while working. Little influence from home office characteristics on self-reported occupational sitting or experienced change in OSB while working from home was found, although the work location in the home may matter for sitting time.

**Figure 3**

*Box Plots of Sitting During Work Time in Minutes per Place of Home Office*




*Note*. The bold line within the borders represents the median value, the lower and upper borders indicate the 25th and 75th percentiles. Whiskers represent values within 1.5 x interquartile range. Dots show outliers.

## 3.3 Socioecological Factors Related to OSB in Home Office Environments

### *3.3.1 Social-Cognitive Factors Related to OSB*

Table 5 presents findings on attitudes towards health effects of OSB and perceived behavioural control of work time standing. Almost every participant saw health-related benefits in taking sedentary breaks at least every 30 minutes (85%) and in being as active as possible throughout the working day (96%). Moreover, the vast majority perceived sitting for most of the time to be unhealthy (90%). Surprisingly, given these findings, over half the sample (54%) believed that deleterious health effects from prolonged sitting can be attenuated by exercise. Finally, only about half of the sample (47%) indicated perceiving to have control over sitting or standing while working from home. Another third (36%) thought this was not the case. All in all, reducing OSB was mostly seen as beneficial, although not always necessary or possible during workhours.

**Table 5**

*Frequencies and Mean Scores of Social-Cognitive Factors Related to OSB and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|
| | (Strongly) agree | Neutral | (Strongly) disagree | | | OSB at home [a] | Experienced change [b] |
| Perceived benefits of being active during work time (scale mean) | | | | 1.58 | 0.57 | -.08 | -.01 |
| It is beneficial for my health to stand up at least every 30 minutes while working at home | **96 (85%)** | 16 (14%) | 1 (1%) | | | | |
| It is beneficial for my health to be as active as possible throughout the working day | **109 (96%)** | 4 (4%) | 0 (0%) | | | | |
| Sitting for most of the time is bad for my health | **102 (90%)** | 8 (7%) | 3 (3%) | 1.60 | 0.77 | -.01 | .27** |
| Any health impacts of prolonged sitting can be offset by exercise at other times of the day | **61 (54%)** | 23 (20%) | 29 (26%) | 2.66 | 1.11 | .07 | -.02 |
| It is my choice whether to sit or stand while working from home [1] | **54 (47%)** | 19 (17%) | 41 (36%) | 2.82 | 1.54 | -.02 | -.12 |

*Note*. $n = 113$, except for: [1] $n = 114$; variables were measured on a scale of 1–5; Boldface denotes most frequent response.
[a] Spearman correlation of variable with occupational sitting time at home in minutes; [b] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

### *3.3.2 Perceived Ability to Reduce OSB in the Home Office*

The statistics of perceived ability of standing or otherwise reducing sitting time while working from home are presented in Table 6. The majority of the sample (84%) reported perceiving difficulty in standing during work, which may be due to physical aspects of the workspace such as being confined to working at a desk without an alternative allowing to stand (c.f. Table 4). When compared to their usual workspace at the organisation, most participants (68%) recognised greater difficulty in reducing sitting time in the home office. Giving an opportunity for the occasional sedentary break, three quarters of the sample (74%) had to get up in order to get a drink. Overall, responses indicated perceived difficulty or inability to reduce occupational sitting time at home.

**Table 6**

*Frequencies and Mean Scores of Perceived Ability to Reduce Occupational Sitting in the Home Office and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|
| | (Strongly) agree | Neutral | (Strongly) disagree | | | OSB at home [a] | Experienced change [b] |
| Able to stand during work (scale mean) | | | | 4.22 | 1.11 | .04 | .05 |
| Able to stand in workspace | 14 (12%) | 5 (4%) | **97 (84%)** | | | | |
| Able to use PC while standing | 11 (10%) | 2 (2%) | **102 (88%)** | | | | |
| Able to interact with colleagues while standing | 33 (28%) | 9 (8%) | **74 (64%)** | | | | |
| Able to talk on phone while standing | **88 (76%)** | 8 (7%) | 20 (17%) | 2.05 | 1.30 | .02 | -.20 * |
| Hindrance of physical aspects in reducing sitting | **60 (52%)** | 26 (22%) | 30 (26%) | 2.65 | 1.29 | .01 | .29 * |
| More difficult to reduce sitting compared to at work | **78 (68%)** | 15 (13%) | 23 (19%) | 2.22 | 1.31 | -.05 | .58 ** |
| Walking more than 5 meters to get coffee, tea, or snacks | **86 (74%)** | 3 (3%) | 27 (23%) | 2.18 | 1.42 | -.01 | -.16 |
| Walking more than 5 meters to print or copy | 36 (31%) | 32 (27%) | **48 (42%)** | 3.22 | 1.53 | -.03 | -.02 |

*Note*. $n = 116$; variables were measured on a scale of 1–5; Boldface denotes most frequent response.

[a] Spearman correlation of variable with occupational sitting time at home in minutes; [b] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

### *3.3.3 Social Influences on OSB While Working From Home*

Organisational and social influences are seen as important in OSB. The statistics regarding these are presented in Table 7. Few participants felt supported by the organisation (5%), by colleagues (13%), by management (8%), and (if applicable) by co-habitants (34%) in reducing work time sitting at home. This might indicate a lack of awareness or interest in discussing or cooperatively reducing occupational sitting. Similarly, role modelling in combating OSB was scarcely experienced while working from home (4-11%, see Table 7). Nevertheless, half of the sample (58%) reported experiencing few or no negative social influences when choosing not to sit during work time at home. Thus, while most employees perceived few positive social influences on reducing occupational sitting time, they did not feel obstructed by social aspects either.

**Table 7**

*Frequencies and Mean Scores of Social and Organisational Influences and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | *n*[a] | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|---|
| | (Strongly) agree | Neutral | (Strongly) disagree | | | | OSB at home[b] | Experienced change[c] |
| Organisational influences (scale mean) | | | | 115 | 4.02 | 0.82 | .10 | .08 |
| Received information on reducing OSB from organisation | 14 (13%) | 23 (20%) | **78 (67%)** | 115 | | | | |
| Received support on reducing OSB from organisation | 6 (5%) | 25 (22%) | **84 (73%)** | 114 | | | | |
| Found collegial support on reducing OSB | 15 (13%) | 28 (24%) | **72 (62%)** | 115 | | | | |
| Colleagues are exemplary in reducing OSB | 12 (11%) | 21 (18%) | **82 (71%)** | 115 | | | | |
| Found managerial support on reducing OSB | 9 (8%) | 25 (22%) | **81 (70%)** | 115 | | | | |
| Managers are exemplary in reducing OSB | 5 (4%) | 24 (21%) | **86 (75%)** | 115 | | | | |
| Social influences from co-habitants on OSB (scale mean) | | | | 99 | 3.52 | 1.03 | .02 | .01 |
| Found support from co-habitants in reducing OSB | 34 (34%) | 22 (22%) | **45 (46%)** | 99 | | | | |
| Co-habitants are exemplary in reducing OSB | 10 (10%) | 29 (29%) | **59 (61%)** | 98 | | | | |
| Social influences on sitting in the home office (scale mean) | | | | 116 | 3.58 | 1.01 | .19 * | .13 |
| Hindrance of social aspects in reducing OSB | 35 (30%) | 29 (25%) | **52 (45%)** | 116 | | | | |
| Burden of social influence in standing or moving while working | 9 (8%) | 39 (34%) | **66 (58%)** | 114 | | | | |

*Note*. Variables were measured on a scale of 1–5; Boldface denotes most frequent response; [a] *n* in total of variable.
[b] Spearman correlation of variable with occupational sitting time at home in minutes; [c] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

### *3.3.4 Factors Related to Sedentary Breaks*

Sedentary breaks, such as standing up, separate bouts of sitting time and thus are important to reduce prolonged sitting. Factors influencing these while working from home are described in Table 8. A small majority of the sample had enough time (56%), energy (61%) and lack of stress (44%) for sedentary breaks. In contrast, a substantial group of employees (42%) experienced too much stress. While many participants felt motivated to take sedentary breaks (45%), it may not be the major priority (54%), meaning that it may be more important to work, especially if limited on time and energy. While over a third of the sample (37%) needed more information on the subject, the vast majority (71%) thought of the organisation as encouraging in taking sedentary breaks during work time at home. To summarise, taking sedentary breaks was often hindered by working activity and priorities, and possibly by insufficient information.

**Table 8**

*Frequencies and Mean Scores of Factors Related to Sedentary Breaks and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|
| | (Strongly) agree | Neutral | (Strongly) disagree | | | OSB at home [a] | Experienced change [b] |
| Working activity and sedentary breaks (scale mean) | | | | 2.73 | 1.13 | .07 | .44 ** |
| Having enough time for sedentary breaks | **64 (56%)** | 6 (5%) | 44 (39%) | | | | |
| Having enough energy for sedentary breaks | **70 (61%)** | 10 (9%) | 34 (30%) | | | | |
| Being too stressed for sedentary breaks [1] | 48 (42%) | 16 (14%) | **50 (44%)** | | | | |
| Personal motivation for sedentary breaks (scale mean) | | | | 2.99 | 1.09 | .10 | -.23 * |
| Being motivated for sedentary breaks | **51 (45%** | 29 (25%) | 34 (30%) | | | | |
| Sedentary breaks are of low priority [1] | **60 (54%)** | 12 (10%) | 42 (37%) | | | | |
| Not having enough information on sedentary breaks | 42 (37%) | **46 (40%)** | 26 (23%) | 2.82 | 1.08 | -.05 | .19 * |
| Organisation encourages taking sedentary breaks | **81 (71%)** | 28 (24%) | 5 (5%) | 2.04 | 0.96 | .01 | .01 |
| Able to see co-habitants take sedentary breaks [2] | 34 (33%) | 25 (24%) | **43 (43%)** | 3.25 | 1.28 | .09 | -.21 * |

*Note*. $n = 114$; variables were measured on a scale of 1–5; Boldface denotes most frequent response; [1] Reverse scored in scale; [2] Only participants with at least one co-habitant are reported, $n = 102$.

[a] Spearman correlation of variable with occupational sitting time at home in minutes; [b] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

## 3.4 Changes in Work Aspects due to Working From Home

### *3.4.1 Experienced Changes in Work Aspects While Working From Home*

The previously described characteristics *of the home office environment* should be considered in the *context of the COVID-19 regulations work situation*, that contributed to or caused changes in aspects and consequences of work. The statistics of experienced changes in work aspects are presented in Table 9. The majority (63%) of the sample experienced at least some increase in work pressure, that is, worked more hours (64%) and had an increased workload (61%). One-fifth of the sample (21% and 20% respectively) considered this a considerable increase. Moreover, tasks often took longer to complete for half of the sample (47%). Similarly, half of the sample (48%) took less breaks during workhours, which corresponded to the increase in workload. In brief, increased work pressure and task duration as well as fewer breaks indicated that work took longer when working from home.

**Table 9**

*Frequencies and Mean Scores of Experienced Changes in Work Aspects While Working From Home and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | | | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|---|---|
| | Much more | Somewhat more | About the same | Somewhat less | Much less | | | OSB at home [a] | Experienced change [b] |
| Changes in work pressure (scale mean) | | | | | | 2.25 | 0.80 | -.21 * | -.27 ** |
| Average amount of hours per week working | 25 (21%) | **51 (43%)** | 33 (28%) | 7 (6%) | 3 (2%) | | | | |
| Workload | 24 (20%) | **49 (41%)** | 50 (34%) | 5 (4%) | 1 (1%) | | | | |
| Average duration of tasks | 14 (12%) | 41 (35%) | **42 (35%)** | 21 (18%) | 1 (1%) | 2.61 | 0.94 | -.11 | .07 |
| Number of breaks | 2 (2%) | 23 (19%) | **36 (31%)** | 35 (29%) | 23 (19%) | 3.45 | 1.06 | .11 | -.52 ** |
| Distractions from work | 11 (9%) | **32 (27%)** | 30 (25%) | 26 (22%) | 20 (17%) | 3.10 | 1.24 | .15 | -.20 * |
| Satisfaction in work | 2 (2%) | 11 (9%) | **49 (41%)** | 43 (36%) | 14 (12%) | 3.47 | 0.88 | -.07 | -.04 |
| Communication (scale mean) | | | | | | 4.10 | 0.65 | -.08 | -.04 |
| With colleagues | 1 (1%) | 1 (1%) | 6 (5%) | 47 (39%) | **64 (54%)** | | | | |
| With management [1] | 1 (1%) | 5 (4%) | 24 (21%) | **48 (41%)** | 39 (33%) | | | | |
| With others related to work | 3 (3%) | 3 (3%) | 37 (31%) | **44 (37%)** | 32 (26%) | | | | |

*Note*. $n = 119$, except for: [1] $n = 117$; variables were measured on a scale of 1–5; Boldface denotes most frequent response.
[a] Spearman correlation of variable with occupational sitting time at home in minutes; [b] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

### *3.4.2 Experienced Consequences of Changed Work Aspects While Working From Home*

The findings on experienced consequences of changed work aspects during the COVID-19 regulations are presented in Table 10. Many work aspects were found to be somewhat deteriorating since the COVID-19 regulations. Over one-third of the sample reported worsened work ability (38%) and work effectiveness (35%). Furthermore, over half of the sample (54%) experienced the workload to be worse than usual (c.f. work pressure in Table 9). In other words, a small group of employees experienced hindrance in their work performance while working from home. Next, the decrease in communication (see Table 9) corresponded with a worse outlook on all three communication channels (with colleagues: 77%; with management: 56%; with others: 63%). All this may have attributed to a deterioration of both physical well-being (for 52% of the sample) and social and mental well-being (for 57%). Overall, the data indicated either no substantial or negative work-related consequences caused by the COVID-19 regulations for most participants.

**Table 10**

*Frequencies and Mean Scores of Experienced Consequences of Changed Work Aspects While Working From Home and Correlations With OSB at Home and Experienced Change in OSB*

| Variable | *n* (%) | | | | | *M* | *SD* | $r_s$ | |
|---|---|---|---|---|---|---|---|---|---|
| | Much better | Somewhat better | About the same | Somewhat worse | Much worse | | | OSB at home [a] | Experienced Change [b] |
| Well-being and work performance (scale mean) | | | | | | 3.40 | 0.58 | -.13 | -.21 * |
| Ability to do the job | 5 (4%) | 8 (7%) | **60 (51%)** | 42 (35%) | 4 (3%) | | | | |
| Effectiveness of work | 6 (5%) | 28 (24%) | **43 (36%)** | 36 (30%) | 6 (5%) | | | | |
| Workload | 1 (1%) | 7 (6%) | 47 (39%) | **52 (44%)** | 12 (10%) | | | | |
| Physical well-being [1] | 4 (3%) | 5 (4%) | 48 (41%) | **49 (42%)** | 12 (10%) | | | | |
| Social and mental well-being [1] | 5 (4%) | 5 (4%) | 41 (35%) | **51 (43%)** | 16 (14%) | | | | |
| Communication (scale mean) | | | | | | 3.79 | 0.72 | -.13 | -.14 |
| With colleagues [1] | 3 (3%) | 1 (1%) | 23 (19%) | **64 (54%)** | 27 (23%) | | | | |
| With management [1] | 2 (2%) | 2 (2%) | **47 (40%)** | 45 (38%) | 22 (18%) | | | | |
| With others related to work [1] | 2 (2%) | 4 (3%) | 37 (31%) | **57 (48%)** | 18 (15%) | | | | |

*Note*. $n = 119$, except for: [1] $n = 118$; variables were measured on a scale of 1–5; Boldface denotes most frequent response. [a] Spearman correlation of variable with occupational sitting time at home in minutes; [b] Spearman correlation of variable with experienced change in OSB. * = $p < .05$; ** = $p < .01$.

## 3.5 Association of Socioecological Factors With Self-Reported OSB at Home

A series of Spearman rank-order correlation analyses were conducted to determine the relationships between socioecological factors related to OSB and self-reported sitting time during workhours. The results are presented in Tables 5 to 10. Two relationships with self-reported sitting time were identified: social influences, and experienced change in working pressure. These analyses were followed up with partial correlations controlling for the significant differences in sitting time by education level.

#### *3.5.1 Social Influences on OSB and Self-Reported Occupational Sitting Time at Home*

Perceiving more negative social influences on sitting in the home office was associated with less work time sitting, as shown in a significant but weak correlation: $r_s(113) = .19$, $p = .041$ (see Table 7). However, this curious relation was no longer found when controlling for education level: partial $r_s(112) = .12$, $p = .212$. This means that the relationship was caused by differences per education level, and no true relationship between social influences and self-reported sitting time during work was observed.

#### *3.5.2 Experienced Changes in Work Aspects and Self-Reported Occupational Sitting Time at Home*

Increased work pressure since working from home corresponded with more occupational sitting time at home via a moderate, negative correlation: $r_s(116) = -0.21$, $p = 0.023$ (see Table 9). When controlling for education, this relationship was no longer found (partial $r_s(115) = -.13$, $p = .15$). In conclusion, no significant relationships were found between any socioecological factors related to OSB and self-reported occupational sitting time while working from home.

### 3.6 Association of Socioecological Factors With Experienced Change in OSB

A series of Spearman rank-order correlation analyses were conducted to determine the relationships between socioecological factors related to OSB and experienced change in sitting while working from home. Results of all analyses are presented in Tables 5 to 10. Significant relationships were found for all categories but Social Influences. Initial analyses were followed up with partial correlations controlling for the significant differences in experienced change in OSB by employment type. Finally, regression analyses were conducted on all significant correlations.

#### *3.6.1 Social-Cognitive Factors in OSB and Experienced Change in OSB*

One significant correlate of attitudes towards health effects from OSB with experienced change in OSB was found (see Table 8). While experiencing more sitting during work time at home, participants knew of the detrimental health consequences of prolonged sitting, as a positive, moderate relation showed: $r_s(111) = .27$, $p = .004$, partial $r_s(109) = .24$, $p = .012$. This could be knowledge of the health effects of OSB or conflation with knowledge on physical inactivity. However, it could also refer to awareness of either, including employees feeling less well or less healthy and (partly) attributing this to more sitting (as a consequence of the COVID-19 regulations). This latter interpretation covers only short-term health effects, although these may remind people of possible long-term consequences. In brief, knowing prolonged sitting is bad for one's health was linked with the experienced increase in sitting time.

#### *3.6.2 Perceived Ability to Reduce OSB in the Home Office and Experienced Change in OSB*

Initially three significant correlates were found with perceptions of the home office environment (see Table 5). First, finding oneself hindered in reducing sitting time while working due to physical aspects

of the workspace was moderately, positively correlated ($r_s(114) = .29$, $p = .002$, partial $r_s(112) = .26$, $p = .006$), meaning that more perceived sitting related to perceiving more hindrance from the built environment. Secondly, a strong, positive relation was found with the possibility to reduce occupational sitting at home compared to at the usual workspace at the organisation ($r_s(114) = .58$, $p < .001$, partial $r_s(112) = .56$, $p < .001$). In other words, the change in sitting time resulted from it being more difficult to reduce sitting while working at home. These results suggest that in this sample the home office was experienced to be better suited for seated work, or at least that it was easier to reduce sitting time at the usual office for these participants. Thirdly, a weak, negative relation was found between feeling less able to stand while talking on the phone and more experienced change in sitting time: $r_s(114) = -.20$, $p = .033$. However, this relationship disappeared when controlling for employment type: partial $r_s(112) = -.12$, $p = .203$. Thus, only two significant relationships with perceived ability in the home office were found.

### *3.6.3 Factors Related to Sedentary Breaks and Experienced Change in OSB*

Four significant correlates of experienced change in sitting time with factors influencing sedentary breaks were found (see Table 7). First, work activity interfering in taking sedentary breaks unsurprisingly was associated with more experienced sitting via a negative, moderate relation ($r_s(112) = -.44$ $p < .001$, partial $r_s(110) = -.45$, $p < .001$). Secondly, being less personally motivated to break sitting was linked to more experienced OSB via a negative, moderate relation: $r_s(112) = -.23$, $p = .015$, partial $r_s(110) = -.25$, $p = .008$. Taken together, these results suggest that employees felt themselves (too) busy with work while working from home to occasionally stand up. Additionally, not seeing co-habitants breaking their sitting was related to more experienced sitting in a negative, significant but weak relation [4]: $r_s(112) = -.20$, $p = .033$, partial $r_s(110) = -.24$, $p = .01$. Finally, not having enough information on sedentary breaks was related to experiencing more sitting via a positive, significant but weak relation with information on sedentary breaks ($r_s(112) = .19$, $p = .047$, partial $r_s(110) = .20$, $p = .04$). To conclude, these results suggest that the experienced increase in OSB in this sample is partly caused by employees experiencing difficulty with taking sedentary breaks because of multiple reasons.

### *3.6.4 Experienced Changes in Work Aspects and Experienced Change in OSB*

Initially, three correlates of experienced changes of work aspects with experienced change in sitting time while working from home were found (see Table 9). First, an increase in work pressure related to

[4] The relation shown in Table 7 counted only cases with at least one co-habitant. This correlation was very similar: $r_s(100) = -.21$, $p = .035$ (partial $r_s(98) = -.25$, $p = .012$). Here, the correlation over the entire sample is reported, as this one was subsequently used in the regression analysis for technical reasons (i.e. difficulty with selecting certain cases for only one variable in the regression test) and because of the small value differences between the two.

experiencing more sitting time while working from home, as found in a positive, moderate relation: $r_s(117) = .27$, $p = .003$, partial $r_s(115) = .25$, $p = .006$. In other words, working more hours and the increased workload naturally led to experiencing more sitting. Secondly, taking less breaks was strongly correlated with experiencing more OSB: $r_s(117) = -.52$, $p < .001$, partial $r_s(115) = -.49$, $p < .001$. This coheres with the former finding: more work and less time for work breaks made participants experiencing more sitting when compared to the pre-COVID-19 situation. Thirdly, a weak, negative link between more distractions and more experienced sitting time was initially found: $r_s(117) = -.20$, $p = .029$. This relationship disappeared when controlling for employment type: partial $r_s(115) = -.16$, $p = .083$. Thus, only two significant relationships between experienced change in OSB and experienced change in work pressure and number of breaks were found.

#### *3.6.5 Experienced Consequences of Changed Work Aspects and Experienced Change in OSB*

Finally, one significant correlate of experienced change in OSB with experienced consequences of working from home was found (see Table 10). Worse work performance and well-being was moderately related to experiencing more sitting time: $r_s(117) = -.21$, $p = .02$, partial $r_s(115) = -.24$, $p = .01$. This relation seems complex and multifaceted: work performance and workload being harder may have caused employees to experience more sitting, as it may relate to increased work time. At the same time, experiencing to sit (and work) longer may have caused employees to experience their performance and workload as worse compared to when working at the organisation, where switching tasks (e.g. meeting with a colleague) can effect sedentary breaks and a less tedious workload. Similarly, deteriorating physical and social and mental well-being can be both caused by perceived increased OSB (or: by the underlying cause: needing to sit while working from home) as well as be the cause itself: feeling worse may have caused people to sit more and, consequently, to experience more sitting. In short, the relationship between experienced change in OSB and experienced work performance and well-being at home seems to be complex.

#### *3.6.6 Predicting Experienced Change in OSB*

A two-stage hierarchical multiple regression analysis was conducted with experienced change of OSB as dependent variable. The first stage controlled for the significant differences in experienced change per employment type. All significantly associated correlates of experienced change in OSB were entered in the second stage. These statistics are presented in table 11.

The first model showed that employment classification contributed significantly to the model ($F(2,110) = 3.662$, $p = .029$), accounting for 6% of variation. This reflected the previously found group differences found earlier: PhD students experienced more change in OSB than academic staff. Introducing the significant correlates in the second model explained an additional 49% of the variance,

which was a statistically significant change: $F(12,100) = 9.928$, $p < .001$. Three independent variables were significant predictors of experienced change in OSB. Finding it more difficult to reduce sitting compared to at the organisation and having no information on taking sedentary breaks were positive predictors, indicating that stronger perceived difficulty and lack of information leads to experiencing more OSB at home. Taking less work breaks during workhours was a negative predictor, indicating that a strongly perceived decrease in work time breaks leads to experiencing more sitting while working from home. Employment type was no longer a significant predictor in this model, meaning that the three predictors were not influenced by employment type differences. To summarise, three factors played a role in the experienced change (i.e. the experienced increase) in OSB at home. Ordered in rank of importance, these were:

1. Increased perceived difficulty to reduce occupational sitting time at home compared with at the usual workspace at the organisation.
2. Fewer work time breaks since working from home.
3. Not having enough information on sedentary breaks while working from home.

**Table 11**

*Multiple Linear Hierarchical Regression Analysis on the Contribution of Socioecological Factors to Experienced Change in OSB While Working From Home*

| Variable | *B* | *SE B* | Bias | BCa 95% CI [a] | *p* |
|---|---|---|---|---|---|
| Step 1 ($R^2$ = .062) | | | | | |
| Academic staff | 0.38 | 0.18 | 0.004 | [-0.044, 0.755] | .049 * |
| PhD students | 0.65 | 0.28 | 0.018 | [0.038, 1.279] | .022 * |
| Step 2 ($R^2$ = .554) | | | | | |
| Academic staff | 0.20 | 0.15 | 0.004 | [-0.100, 0.533] | .207 |
| PhD students | 0.25 | 0.23 | 0.011 | [-0.251, 0.780] | .271 |
| Sitting for most of the time is bad for my health | 0.03 | 0.11 | -0.013 | [-0.184, 0.183] | .813 |
| More difficult to reduce sitting compared to at work | 0.28 | 0.07 | 0.002 | [0.143, 0.413] | .001 ** |
| Working activity and sedentary breaks | -0.03 | 0.09 | 0.001 | [-0.202, 0.143] | .731 |
| Personal motivation for sedentary breaks | -0.06 | 0.06 | 0.010 | [-0.189, 0.092] | .327 |
| Information on sedentary breaks | 0.15 | 0.07 | 0.003 | [0.010, 0.296] | .040 * |
| Seeing co-habitants taking sedentary breaks | -0.03 | 0.06 | -0.001 | [-0.149, 0.093] | .609 |
| Experienced change in work pressure | 0.05 | 0.10 | 0.005 | [-0.149, 0.268] | .642 |
| Experienced change in number of breaks | -0.22 | 0.10 | -0.008 | [-0.387, -0.062] | .034 * |
| Experienced well-being and work performance | -0.15 | 0.11 | -0.006 | [-0.378, 0.052] | .154 |

*Note*. Results based on 1000 bootstrap samples. [a] Bias-corrected and accelerated bootstrap confidence interval for *B*, with respectively lower and upper limits.

* $p < .05$; ** = $p < .01$.

# 4 Discussion

The purpose of this study was to provide insights into OSB while working solely from home. This was necessitated by regulations following the COVID-19 pandemic, which shaped a new work situation and forced employees to set up and work from home offices. This study was the first to measure occupational sitting time while employees were obligated to work solely or primarily from home, and the first to assess previously found socioecological factors of OSB in the homeworking context. The results indicate that employees were highly sedentary while working from home, which seemed to be influenced by the home office environment and the work situation caused by the COVID-19 regulations. However, no relationships between any socioecological factors and self-reported sitting time while working from home were found. The findings from this study can contribute to developing interventions for reducing prolonged sitting while working from home.

## 4.1 Reported OSB While Working From Home

The results showed that employees of a Dutch university were highly sedentary during workhours while working from home, as well as throughout the entire day. Overall, the employees reported to spent on average over 11 hours or 73% of waking hours sitting. This is notably higher than the Dutch national average of 9.4 hours per weekday, but is consistent with tendencies to sit more in higher educated (RIVM, n.d.) and white-collar or professional workers (Prince et al., 2019; Special Eurobarometer 472, 2018). Reported occupational sitting time was on average 7.25 hours while working from home, or 81% of work time. Using the BQOS in a comparable sample, Van de Lagemaat (2018) found a similar sit-to-work ratio of 79% in (semi-)governmental workers in a typical office. In other words, this level of OSB does not seem to be exceptional in office workers. However, the vast majority (78%) of employees in this study experienced more sitting during work time since working from home. In fact, almost half of all participants (41%) experienced this increase to be significantly more than usual. Therefore, there are indications of increased OSB since employees started to work from home, but the current study could not provide strong evidence for this. Nevertheless, important here is that this high level of OSB is likely to increase risks of chronic diseases and all-cause premature mortality. Consequently, interventions for reducing OSB of employees working from home are needed.

## 4.2 Socioecological Contexts of OSB While Working From Home

The results showed that both the home office environment and the work situation during the working from home regulations were prime contexts for highly sedentary workdays. Meanwhile, social-cognitive aspects seemed potentially favourable for reducing occupational sitting time at home. No evidence was found for any factors having any relationships with sitting time while working from home. Nonetheless, the socioecological framework helps to understand OSB in homeworking.

The vast majority of employees (85–96%, see Table 5) reported positive instrumental attitudes towards reducing OSB. Due to the predictive value of attitude as hypothesised in theoretical approaches for OSB, a significant association between attitude and occupational sitting time was expected. However, no such relationships were found. Possibly, this is because instrumental aspects of attitude (beliefs on health benefits) seem less relevant for reducing OSB than experiential aspects of attitude towards OSB (beliefs on pleasantness and enjoyment; Lithopoulos et al., 2020). The findings point towards the related concepts of awareness and knowledge. First, although participants were not asked if they were aware that these risks applied to themselves, many people are aware that prolonged sitting is part of an unhealthy lifestyle (Van de Lagemaat, 2018). But that does not imply that employees were aware of their *own* long sitting times. While the majority of employees reported to experience more sitting while working from home, some participants mentioned that they became conscious of sitting too much only by partaking in the survey. This suggests that actual awareness of OSB, and with that awareness of personal health risks by OSB, may be low in these university employees.

Furthermore, the knowledge informing the instrumental attitudes may be flawed or limited. For instance, half of the participants (54%) believed prolonged sitting to be less detrimental when being active at other times of the day, which is consistent with previous findings (Sudholz et al., 2018; Wang et al., 2019). Interestingly, lack of information on sedentary breaks was associated with experiencing more OSB since working from home. This information might pertain to not knowing of reasons to break occupational sitting (i.e. *why*) or to finding opportunities to do so (i.e. *how*). Consequently, awareness of OSB and personal consequences of prolonged sitting, as well as knowledge on OSB may be useful constructs to promote reducing OSB at home. Moreover, education might help in increasing perceived capabilities in limiting and breaking up occupational sitting.

The results showed that only half of all participants (47%) perceived to have control over their standing behaviour while working from home. No direct relationship between perceived behavioural control and OSB was found in this study, mirroring earlier studies (Hadgraft, Healy, et al., 2016; Wilkerson et al., 2018). However, perceiving more difficulty to reduce OSB at home compared to at the organisation's office was related with experiencing more OSB. Moreover, the majority of participants (64-88%, see Table 6) reported not being able to stand while working in the home office. First, this suggests that perceived behavioural control was not measured optimally in this study or that self-efficacy to overcome barriers inhibiting OSB reduction should also be assessed (e.g. perceiving to be able to stand *even with an excessive workload*). Secondly, this indicates that certain issues with control may impede the ability to reduce OSB. Partly, the low levels of perceived control might be explained by the set-up of home offices and the work situation.

The home office environments used by the employees were mostly equipped for seated work and not conducive towards reducing OSB. Almost all participants worked primarily from a sitting desk or table (93%) and office or dining chair (92%). This was expected, as sitting during work is the norm for most office workers and HAD are expensive purchases. Sitting alternatives such as HAD or balance ball chairs were hardly used by employees, both previously at the office *and* at the home office. This was because these alternatives were not available to employees. Without proper alternatives standing while working becomes challenging, especially for computer work. Consequently, and with relative few employees being satisfied with their home workspace furniture, home office environments might be interesting targets for HAD-introducing interventions. On the other hand, half of the participants (52%) perceived no hinderance by physical aspects in reducing work time sitting, implying either a lack of interest in reducing OSB or that difficulties lay elsewhere.

Although none of the work aspects was directly associated with self-reported sitting time, the COVID-19 homeworking situation seemed unfavourable for OSB reduction. The results showed that a small majority of participants (63%) experienced more work pressure. Moreover, a substantial number of participants reported not having enough time (39%) and being too stressed (44%) to break sitting time while working from home. Workload and stress are often discussed in qualitative studies as barriers favouring OSB and, in particular, towards sedentary breaks (Hadgraft et al., 2018; Hadgraft, Brakenridge, et al., 2016; Mackenzie et al., 2019; Ojo et al., 2019; Wang et al., 2019). Above breaking up prolonged sitting, employees often are too immersed in work or actively prioritise work tasks (Dewitt et al., 2019; Such & Mutrie, 2017). In this study, half of the employees (48%) took fewer breaks while working from home, which was associated with experiencing more occupational sitting. Some participants reported on a case level not standing up to get a drink or quickly getting back to sitting and working as they lacked a need or excuse to keep standing or walking (e.g. talking to co-workers). Missing these opportunities to reduce sitting time may have influenced the perception of sitting more than usual. Interestingly, the health benefits from sedentary breaks could be suggested as good reasons for small breaks in work time. However, in case of high workload and less or no social motivation, sedentary breaks should be promoted with worker efficiency in mind.

From the socioecological perspective, a new potential influence in OSB can be posited. Employees had less *perceived need* to stand up or move during workhours while working from home. As reported by participants on a case level and found in other studies (Loffler et al., 2015; Mullane et al., 2017), employees are used to and often *required* to move at work, for instance going to other workspaces (e.g. lecture halls or meeting rooms), and meeting co-workers for break purposes (including lunch walks) or to discuss work. Homeworking means that there is less perceived need to walk around, which leads to more perceived, and probably actual, sitting. Thus, perceived need may

affect actual and perceived opportunities in reducing OSB (see e.g. Ojo et al., 2019). This notion needs to be further examined in future studies, such as the accompanying qualitative study.

Additionally, this study highlighted the influences from changes in environments and work situations on OSB. The COVID-19 homeworking regulations illustrated the influence that (changes in) work situations can have on occupational sitting, such as increased work pressure discouraging sedentary breaks. Consequently, both environmental and situational contexts can be used or need to be acknowledged in OSB reduction interventions. Similarly, future studies should consider work situations as well when investigating individual and environmental factors in OSB, for example by using mixed-method approaches to contextualise quantitative measures.

### 4.3 Practical Recommendations on Reducing OSB While Working From Home

Based on these early findings, a few recommendations for reducing prolonged occupational sitting at home can be made. As organisations are starting to provide information on healthy home workspaces (e.g. counteracting repetitive strain issues), the following recommendations should be added to reduce OSB in employees for *long-term* health benefits. These strategies should be pragmatic and context-specific (Stephens et al., 2018), thus accounting for the context of the COVID-19 regulations.

Practical measures can be taken by informing employees on work breaks. That is, providing reasons and means to take (small) breaks at home and use these breaks to break up sitting bouts. Although often dissuaded by heavy workload, work time breaks have not been found to negatively influence productivity (Waongenngarm et al., 2018). As sedentary breaks are more likely to be initiated after work tasks are completed (Dewitt et al., 2019), employees should be encouraged to schedule in breaks and use these to change posture. Office workers could use scheduling techniques such as Pomodoro, which encourages people to focus on one (sub-)task for (traditionally) 25 minutes, followed up by a 3 to 5 minute break (Cirillo, n.d.). Additionally, technologies such as software applications (e.g. *Workrave*) or devices can provide reminders. Many wearable devices (e.g. Fitbits, smartwatches) already include prompts to move when users are inactive for prolonged time (Diamond & Byrd, 2020). Ideally, this scheduling of sedentary and work time breaks should result in habit formation. Additionally, employees could drink more water to increase bathroom breaks (De Cocker et al., 2015; Stephens et al., 2018). As discussed, interventions for encouraging breaks may additionally benefit from raising knowledge on and awareness of both OSB and health consequences of prolonged sitting.

Furthermore, home offices should ideally include means to enable work time standing. Adding HAD to workspaces *with* instructions on how to use those properly can reduce OSB by almost two hours per workday (Shrestha et al., 2016) without hindering or possibly even improving work productivity (Chambers et al., 2019; Sui et al., 2019). Moreover, adding to and restructuring environments are among the more successful strategies for interventions to reduce OSB (Becker et al.,

2019; Gardner et al., 2016) and SB in general (Blackburn et al., 2020). Future solutions may be to financially incentivise alternative sitting facilities such as HAD or provide means to rent or lease these furniture. Meanwhile, cheaper and effective (temporary) solutions are to create makeshift standing workstations by using ironing boards, counters or high-top tables or by heightening monitors, webcams and input devices with books, boxes or clothes baskets (see also Davis et al., 2020). All these options should be accompanied with instructions on ergonomically proper use of standing options. That is, it should prevent both long-term health consequences of too much prolonged sitting and short-term health effects (e.g. musculoskeletal issues; Davis et al., 2020); thereby encouraging actual usage of the standing option (Chau et al., 2016; Shrestha et al., 2016). Moreover, employees should be informed on the key advise: change posture regularly; neither sit nor stand for too long!

### 4.4 Strengths and Limitations of the Study

Strengths of this study include the study design, combining a substantial survey with additional qualitive questions, and the sample consisting of multiple job classifications. Through the socioecological approach, this study addresses influences from contextual shifts on OSB, and describes potential socioecological factors in the home office environment.

Limitations of this study should also be acknowledged. First of all, the study used a self-report survey design, preventing preferable objective measures of OSB. However, the BQOS uses a multi-item method, improving accuracy and validity in self-report sitting time measures (Prince et al., 2020). Secondly, the cross-sectional design does not allow for determination or causation, or to observe whether there are potential moderators or mediators (Bauman et al., 2002). However, given the COVID-19 circumstances and the short time frame for this study, the online survey setup was the most prudent option. This time pressure also meant that the questionnaire could not be tested before conducting the study. Most items were based on previously validated scales, but modifications to the homeworking situation affected the usability of these scales. This resulted in having to use single-item measures for many socioecological factors, which have less statistical power (Heo et al., 2015).

The sample size was another limitation. Total survey completion was too small (n = 113), just approximating the required sample size of 118 for the linear regression analysis, which may have affected the findings. Finally, the exploratory nature of the cross-sectional study as well as the non-random sampling method at one organisation limits the generalisability of the findings. The relatively high number of highly educated participants as well as the small sample size means that the findings may not generalisable to all office workers.

### 4.5 Implications for Further Research

Further research is needed for more insights into OSB in employees primarily working from home. Ideally, OSB while homeworking is measured objectively. This has the added benefit of providing data on sedentary breaks, which seem to be affected by the homeworking situation and are important targets for OSB interventions. Alternatively, such data could be gathered using an experience sampling method with short recall periods (Prince et al., 2020).

This study investigated known factors in OSB previously observed in typical office environments. New factors in OSB may have been introduced via the home environment or the COVID-19 work situation, as seen with (lack of) perceived need to move as a possible addition to the socioecological model. As this study could not find relationships between socioecological variables and OSB, other factors not tested, such as habits and routines, are likely to play an important role. Qualitative research methods, including the accompanying qualitative study, might provide insights into other new possible additions or other factors to study.

Finally, this study found limited evidence that environments can influence the level of OSB while working from home, for example via the room people work in as well as the type of office furniture. However, specific factors in these environments, such as (for example) connectivity are unknown. Similarly, as there were few participants with sitting alternatives available, it remains unsure if these reduce occupational sitting time at home. New studies focusing on physical aspects of home offices may provide insights in how to better reduce OSB at home.

## 5 Conclusions

This study shows that office workers are very much sedentary while working from home during the COVID-19 regulations. Furthermore, it indicated but could not provide strong evidence that employees were more sedentary than usual; participants experienced more sitting and less physical activity during work time. Additionally, home offices and the work situation seemed to be potential influences of socioecological factors in OSB at home. Further research in more diverse populations is necessary to strengthen generalisability, to identify additional factors, and to provide information on sedentary breaks while working from home. Additionally, (changes in) work situations should be considered to contextualise future studies and interventions in OSB. Future interventions on reducing OSB in teleworkers should focus less on social influences and more on providing information on and habitualising sedentary breaks during work time, as well as making practical changes to home offices, such as introducing HAD or makeshift standing workspaces.

### Take Home Messages

Teleworkers should decrease their sedentary time by standing more and by breaking up their sitting time. Organisations and employees should enable opportunities to work while standing by introducing or creating ergonomically proper (makeshift) standing workstations. Additionally, possible strategies to break up sitting time are drinking more water to increase bathroom breaks, and setting timers or prompts to regularly change posture after (sub)tasks, for example every 30 minutes.

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# Appendix A

## Management Summary

Too much prolonged sitting is associated with preventable, long-term health risks such as chronic illnesses and premature death, independently from physical activity levels. Occupational sitting should thus be discouraged. This study reports on a survey conducted on 119 employees working from home during the COVID-19 regulations. It shows that employees were highly sedentary during the COVID-19 homeworking regulations, seemingly more than usual. The most important findings were:

- Employees sat too much during workhours. Sitting time was on average 7.25 hours/day while working, or 81% of work time. The majority of workers experienced more sitting and less standing and moving since working from home. Findings suggest that awareness of sitting time and of personal health consequences of this behaviour were low.
- Home offices were primarily equipped for seated work. The vast majority of employees worked at a sitting desk or table (93%) and sat on an office or dining chair (92%). Satisfaction with furniture was relatively low: 57% of participants were at least satisfied with the desk, 60% with the seat. Sitting alternatives were hardly used, as these often were not available.
- Work pressure was increased. Employees experienced working more hours, having more and worse workload and taking less breaks. Consequently, employees were less likely to break up their sitting bouts.
- Experiencing more sitting time was associated with a) perceiving more difficulty to reduce sitting time at home compared to at the office, b) taking fewer work beaks at home; and c) not having enough information on breaking up sitting time while working from home.

Following these findings, we recommend:

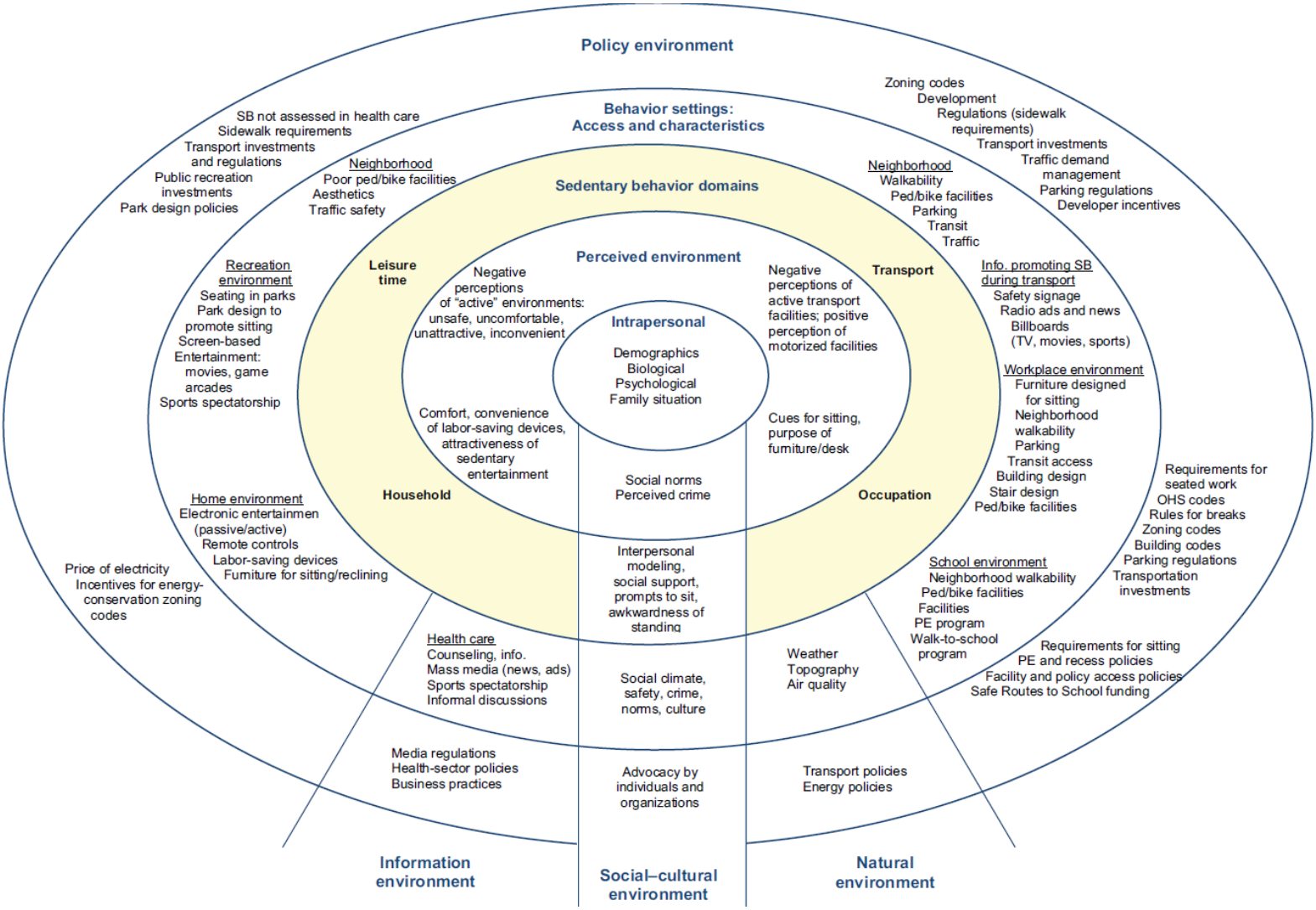
1. Including work time sitting as a point of attention for occupational health, in *addition* to physical inactivity and RSI risks. Key is for employees to try to change posture every 30 minutes to prevent OSB-associated health risks.
2. Informing employees on how to break up work time and to use these breaks to stand or move. Possible strategies to occasionally break up sitting time in home offices are drinking more water, using prompts, such as via software (Workrave) or wearables (Fitbit, smartwatches), or by scheduling in breaks after each (sub)task, for instance with the Pomodoro technique.
3. That, similar to healthy seated home workstations, employees should be informed on how to set up (makeshift) standing workstations, as well as what are appropriate postures for standing while working.
    - Additionally, looking into possibilities for employees to rent or lease height-adjustable desks or other sitting alternatives for teleworking.

# Appendix B

## Socioecological Framework for Understanding (Occupational) Sedentary Behaviour

**Figure B1**

*Socioecological Model of Four Domains of Sedentary Behaviour*




*Note*. Abbreviations: OHS = occupational health and safety; PE = physical education; Ped = pedestrian; SB = sedentary behaviour. This figure was adopted from Owen et al. (2011)

# Appendix C

## Opening Statement and Informed Consent Before Participation of Survey

**Opening statement**

You are invited to participate in a study titled **Working from home during the COVID-19 regulations**. The purpose of this research study is to find out how employees of [organisation] find themselves affected by working from home with regards to aspects of their work, as well as how physical active they are and how much time they spend sitting during the workday.

This study is performed by Gerko Schaap (UT student of Health Psychology & Technology), supervised by the University of Twente. If you would like to contact him, please e-mail g.schaap@student.utwente.nl. The anonymous questionnaire will take you approximately 20 minutes to complete. Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any question.

We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimise any risks by securing your answers safely and use the server of the [University of Twente] for storage of the data. Moreover, all collected data is anonymous, as no questions will ask you to answer with information which will make it able to identify you personally.

Before commencing with the questionnaire, we ask for your approval of participation in this study. [**page break**]

**Informed consent**

Principal researcher: Gerko Schaap, student University of Twente (g.schaap@student.utwente.nl)

Thesis supervisor: Dr Christina Bode, Department of Psychology, Health & Technology, University of Twente

I acknowledge that I understand the method and aims of this study, and that I participate voluntarily. I am aware that the collected data and results are only anonymously published to others. I am aware that I may choose to withdraw from participation at any moment without any reason given.

Please give your consent by ticking the following box:

- o I consent
- o I do not consent [if this option was taken, participants were sent to end of survey]

# Appendix D

## Survey Working From Home During the COVID-19 Regulations

**Screening**

Do you currently work from home (i.e. not at the campus/other (non-home) usual place of work)?

- Yes
- No [→ *participants are forwarded to* ***end-of-survey message A***]

Please indicate by moving the slider how many hours a week are you appointed to work at [organisation]:

Not applicable, I do not work at [organisation] [→ *participants are forwarded to* ***end-of-survey message A***]

| | 0 8 16 24 32 40 |
|---|---|
| Work hours/week () |  |

**Demographics**

What is your age?

_____

What is your gender?

- Male
- Female
- Other/prefer not to say

What is your highest education?

- Secondary school (*middelbaar onderwijs*)
- Intermediate vocational education (*middelbaar beroepsonderwijs*)
- Higher professional education (*hoger beroepsonderwijs*)
- Academic education (*wetenschappelijk onderwijs*)
- Advanced degree (e.g. PhD)
- Other, namely: _____

What is your employment classification?

- PhD student
- Academic staff
- Support and management staff

Are you physically able to stand for prolonged time (≥ 15 minutes uninterrupted)?

- Yes
- No

What type of office do you have at [the organisation]?

- o Shared
- o Private
- o Other, namely: _____

How often did you on average work from home before the COVID-19 regulations?

- o Always
- o Multiple days per week
- o Once a week
- o Once a month
- o Almost never
- o Never

**Aspects of work**

Please indicate to which degree you find changes affected by the COVID-19 regulations/working from home compared to usual (i.e. work at [organisation]) in the following:

| | Much better than usual | Somewhat better than usual | About the same as usual | Somewhat worse than usual | Much worse than usual |
|---|---|---|---|---|---|
| The average amount of hours per week I am working | ○ | ○ | ○ | ○ | ○ |
| The average duration of my tasks (e.g. work taking longer or shorter to complete) | ○ | ○ | ○ | ○ | ○ |
| The amount of breaks I take | ○ | ○ | ○ | ○ | ○ |
| My workload | ○ | ○ | ○ | ○ | ○ |
| Distractions from my work | ○ | ○ | ○ | ○ | ○ |
| Communication with my colleagues | ○ | ○ | ○ | ○ | ○ |
| Communication with management | ○ | ○ | ○ | ○ | ○ |
| Communication with others I work with (e.g. students, research participants or partners, etc.) | ○ | ○ | ○ | ○ | ○ |
| Satisfaction in my work | ○ | ○ | ○ | ○ | ○ |
| Sitting during work time | ○ | ○ | ○ | ○ | ○ |
| Standing during work time | ○ | ○ | ○ | ○ | ○ |
| Moving around/walking during work time | ○ | ○ | ○ | ○ | ○ |
| Other, namely (1): | ○ | ○ | ○ | ○ | ○ |
| Other, namely (2): | ○ | ○ | ○ | ○ | ○ |

Please indicate how you experience the following aspects of working from home as compared to work as usual (i.e. work at [organisation]):

| | Much better than usual | Somewhat better than usual | About the same as usual | Somewhat worse than usual | Much worse than usual |
|---|---|---|---|---|---|
| The ability to do my job in general | ○ | ○ | ○ | ○ | ○ |
| My workload | ○ | ○ | ○ | ○ | ○ |
| The effectiveness of my work | ○ | ○ | ○ | ○ | ○ |
| Communication with my colleagues | ○ | ○ | ○ | ○ | ○ |
| Communication with management | ○ | ○ | ○ | ○ | ○ |
| Communication with others I work with (e.g. students, research participants or partners, etc.) | ○ | ○ | ○ | ○ | ○ |
| My physical well-being | ○ | ○ | ○ | ○ | ○ |
| My social and mental well-being | ○ | ○ | ○ | ○ | ○ |
| Other, namely (1): | ○ | ○ | ○ | ○ | ○ |
| Other, namely (2): | ○ | ○ | ○ | ○ | ○ |

Please indicate how you experience the following:

| | Not at all | Not really | Undecided | Somewhat | Very Much |
|---|---|---|---|---|---|
| Do you experience a shift in proportions between aspects of your work (e.g. between education and research)? | ○ | ○ | ○ | ○ | ○ |
| Do you enjoy this shift in proportions between aspects of your work (e.g. between education and research)? | ○ | ○ | ○ | ○ | ○ |

**Sitting time [Brief Questionnaire on Occupational Sitting (BQOS)]**

For the next questions, imagine your activity pattern on a regular working day since you started working from home due to COVID-19 regulations. To get reliable information, we ask you for points in time and time spans to map your activity pattern as realistic as possible.

The green questions ask for points in time.
The blue questions ask for time spans.

Examples of answers to the green questions:
7.15 is entered as follows: Hours '7' and Minutes '15'.
You enter 22.00 as: Hours '22' and Minutes '00'

Examples of answers to the blue questions
If you sat for 20 minutes, enter: Hours '0' and Minutes '20'.
If you sat for 4.5 hours, enter: Hours '4' and Minutes '30'

Please always enter something.

| | Please enter both hours and minutes<br>Hours Minutes |
|---|---|
| When do you usually wake up on a regular workday? | |
| When do you usually start working? | |
| How much time do you spend sitting in the aforementioned period, from waking up to starting to work? (Think of breakfast, watching television, etc.) | |
| When do you usually stop working? | |
| How much time do you spend sitting between the moment of starting and stopping to work? (Think of working at your desk, during breaks, meetings, etc.) | |
| When do you usually go to bed after a regular workday? | |
| How much time do you spend sitting on average between stopping work and bedtime? (Think of dinner, television, computer, on the couch, etc.) | |

How often did you use facilities that reduce sitting time or are alternatives to normal chairs when you worked **at [organisation]**? Think of high conference tables, sit-stand desks, sitting balls, a knee-chair, desk bike, etc.

- Daily or almost daily
- Once or twice a week
- Once or twice a month
- A few times in a year
- Never
- Other, namely: _____

How often did you use facilities that reduce sitting time or are alternatives to normal chairs when you worked **currently at home**? Think of high (standing) tables/counters, sit-stand desks, sitting balls, a knee-chair, desk bike, etc.

- Daily or almost daily
- Once or twice a week
- Once or twice a month
- A few times in a year
- Never
- Other, namely: _____

**Home work environment**

With how many others do you share your home?

- Adults (e.g. partner; housemates): _____
- Children: _____
- Pets: _____

Where do you work most of the time?

- (Temporarily) dedicated office/study room
- Kitchen/dining room
- Living room: dedicated study place (not used for leisure time)
- Living room: same place as for leisure
- Main bedroom
- Other, namely: _____

What type of desk do you most often use?

- Sitting desk or table (or equivalent)
- Sit/stand desk
- Standing desk or table (or equivalent)
- Other, namely: _____

How satisfied are you with this piece of desk furniture?

- Extremely satisfied
- Moderately satisfied
- Neither satisfied nor dissatisfied
- Somewhat dissatisfied
- Extremely dissatisfied

What type of seating option do you most often use?

- Office chair
- Dining chair
- Living room chair/comfortable (lounge) chair
- Couch
- Alternative furniture (e.g. sitting ball or knee chair)
- None (mostly standing)
- Other, namely: _____

How satisfied are you with this piece of sitting furniture?

- Extremely satisfied
- Moderately satisfied
- Neither satisfied nor dissatisfied
- Somewhat dissatisfied
- Extremely dissatisfied

How often do you share your workspace with others?

- Always
- Most of the time
- About half the time
- Sometimes
- Never

Please indicate to what level you agree with the following statements regarding your workspace at home:

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| In my current workspace, I am able to stand while working | ○ | ○ | ○ | ○ | ○ |
| In my current workspace, I am able to use my PC while standing | ○ | ○ | ○ | ○ | ○ |
| In my current workspace, I am able to talk on the phone while standing | ○ | ○ | ○ | ○ | ○ |
| In my current workspace, I am able to interact with colleagues or hold meetings via e.g. a web conferencing application) while standing | ○ | ○ | ○ | ○ | ○ |
| Compared to working at my usual UT working place, it is more difficult for me to reduce my sitting time when working at home | ○ | ○ | ○ | ○ | ○ |
| Physical aspects of my home office workspace hinder me to reduce my sitting time while working from home | ○ | ○ | ○ | ○ | ○ |
| Social aspects of my home office workspace hinder me to reduce my sitting time while working from home | ○ | ○ | ○ | ○ | ○ |
| I feel burdened by social influences regarding standing or moving (i.e. instead of sitting at your desk) while working at home | ○ | ○ | ○ | ○ | ○ |
| To get coffee/tea/a snack, I usually get up and walk more than 5 meters | ○ | ○ | ○ | ○ | ○ |
| To print or make a copy, I usually get up and walk more than 5 meters | ○ | ○ | ○ | ○ | ○ |

**Social environment**

Please indicate to what level you agree with the following statements:

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| I have received information from [organisation] on how to reduce sitting time while working from home | ○ | ○ | ○ | ○ | ○ |
| I receive support from [organisation] to reduce sitting time while working from home | ○ | ○ | ○ | ○ | ○ |
| I find myself supported by colleagues to reduce sitting while working from home (e.g. motivated to go for a walk during work time; to stand while working) | ○ | ○ | ○ | ○ | ○ |
| I find myself supported by managers to reduce sitting while working from home | ○ | ○ | ○ | ○ | ○ |
| My colleagues are an example to me for reducing sitting time while working from home | ○ | ○ | ○ | ○ | ○ |
| My managers are an example to me for reducing sitting time while working from home | ○ | ○ | ○ | ○ | ○ |

Please indicate to what level you agree with the following statements:

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree | Not applicable |
|---|---|---|---|---|---|---|
| I find myself supported by co-habitants to reduce sitting while working from home | ○ | ○ | ○ | ○ | ○ | ○ |
| My co-habitants are an example to me for reducing sitting time while working from home | ○ | ○ | ○ | ○ | ○ | ○ |

**Breaks in sitting time**

The following statements are about sedentary breaks. These refer to **taking a break from sitting, not** to breaks in which you sit. In other words, sedentary breaks are significant changes in posture, such as standing up and/or going for a walk (e.g. going to get coffee).

Please indicate to what level you agree with the following statements on sedentary breaks while working from home:

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| I have enough time for sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |
| I have enough energy for sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |
| Sedentary breaks are a low priority for me while working at home | ○ | ○ | ○ | ○ | ○ |
| There is not enough information about taking sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |
| I have too much stress when I work from home to take sedentary breaks | ○ | ○ | ○ | ○ | ○ |
| I am motivated to take sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |
| I can see my housemates taking sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |
| The university should encourage sedentary breaks while working at home | ○ | ○ | ○ | ○ | ○ |

**Individual aspects**

Please indicate to what level you agree with the following statements:

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| It is my choice whether I stand up or sit at my desk while working at home | ○ | ○ | ○ | ○ | ○ |
| Sitting for most of the time while working at home is bad for my health | ○ | ○ | ○ | ○ | ○ |
| Any health impact of sitting for most of the time while working at home can he off-set by exercising at other times of the day | ○ | ○ | ○ | ○ | ○ |
| It is beneficial for my health to stand up at least once every 30 minutes while I work at home | ○ | ○ | ○ | ○ | ○ |
| It is beneficial for my health if I am as active as possible throughout the day (e.g. by using the stairs as often as possible or by going for a walk) | ○ | ○ | ○ | ○ | ○ |

**Experiences**

In addition to what you answered already, what are your experiences with working from home during the COVID-19 regulations in your situation? [5]

_____
_____
_____
_____
_____

What are your experiences with sitting time while working in general?

_____

In addition to what you answered already, what are your experiences (e.g. changes compared to working at [organisation] with sitting whilst working from home?

_____

In case you tried to reduce sitting time, which barriers did you experience in the current situation whilst working from home?

_____

In case you tried reducing sitting time, what for you are current enablers to reduce sitting time whilst working from home?

_____

Do you have additional thoughts you would like to share related to sitting in the current home office situation?

_____

Do you have further general remarks you want to share?

_____

End of survey [***Participants are forwarded to end-of-survey message B***]

**End-of survey message A (not meeting the screening criteria)**

We're sorry, but you do not meet the qualifications for this survey. We thank you for your time and interest. you can close this tab now.

**End-of survey message B (completing the survey)**

Thank you very much for your participation in this study. You can close this tab now.

If you have any questions or remarks regarding the research or if you want a summary of the findings, you can contact the principal researcher via g.schaap@student.utwente.nl.

[5] These lines indicate a 'essay text' answer option. All subsequent open questions originally had the same, virtually unlimited amount of space to answer.

# Appendix E

## Principal Component Factor Analysis of Social-Cognitive Factors in OSB

Five items related to social-cognitive factors of OSB were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table E1). All communalities were above .3, indicating each item sharing some common variance with other items. Likewise, the Kaiser-Meyer-Olkin measure of the sampling adequacy was .61, just above the recommenced value of .6. Bartlett's test of sphericity was significant: $\chi^2(10) = 60.14$, $p < .001$. Both these tests indicate the set of items as at least adequately related for factor analysis. The analysis yielded two factors explaining 60% of the variance. Factor 1 relates to perceived benefits of being active during work time. Factor 2 relates to personal control over being active. One item loaded on both factors and was therefore kept out of the potential subscales.

**Table E1**

*Factor Analysis Table for Social-Cognitive Factors in OSB*

| Item | Loadings | | |
|---|---|---|---|
| | Factor 1 | Factor 2 | Communality |
| Beneficial to be active throughout the day | .842 | | .708 |
| Beneficial to stand up every 30 minutes | .839 | | .707 |
| Sitting for most of the time is unhealthy | .568 | -.458 | .532 |
| Health impact from sitting can be offset by exercise | | .740 | .551 |
| It is my choice to sit or stand | | .717 | .520 |
| Eigenvalue | 1.835 | 1.185 | |
| % of total variance | 36.692 | 23.694 | |
| Total variance | | 60.386% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix F

## Principal Component Factor Analysis of Perceived Ability to Reduce OSB in the Home Office

Ten items related to perceived ability to reduce occupational sitting in the home office were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table F1). Almost all communalities were above .3, indicating each item sharing some common variance with other items. Likewise, the Kaiser-Meyer-Olkin measure of the sampling adequacy was .65, above the recommenced value of .6. Bartlett's test of sphericity was significant: $\chi^2(45) = 359.74$, $p < .001$. Both these tests indicate the set of items as at least adequately related for factor analysis. The analysis yielded two factors explaining 46% of the variance. Factor 1 relates to perceived ability to work while standing. Factor 2 relates to social influences in the home office. The remaining items loaded on multiple factors.

**Table F1**

*Factor Analysis Table for Perceived Ability to Reduce OSB in the Home Office*

| Item | Loadings | | | | |
|---|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Communality |
| Able to use PC while standing | .915 | | | | .853 |
| Able to work while standing | .899 | | | | .836 |
| Able to interact while standing | .823 | | | | .702 |
| Able to use phone while standing | .419 | | | | .258 |
| Burdened by social influences in standing or moving | | .843 | | | .741 |
| Social aspects of workplace hinder in reducing sitting | | .809 | | | .761 |
| More difficulty to reduce sitting compared to usual workplace | | | .842 | | .720 |
| Physical aspects of workplace hinder in reducing sitting | -.326 | | .680 | | .609 |
| Walk more than 5 meters to print or copy | | | | .882 | .802 |
| Walk more than 5 meters to get coffee, tea, or a snack | | -.351 | | .680 | .636 |
| Eigenvalue | 2.958 | 1.678 | 1.228 | 1.054 | |
| % of total variance | 29.58 | 16.783 | 12.281 | 10.540 | |
| Total variance | | | | 69.179% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix G

## Principal Component Factor Analysis of Social Influences on OSB

Eight items related to social influences on occupational sitting were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table G1). All communalities were above .3, indicating each item sharing some common variance with other items. Likewise, the Kaiser-Meyer-Olkin measure of the sampling adequacy was .68, above the recommenced value of .6. Bartlett's test of sphericity was significant: $\chi^2(28) = 449.90$, $p < .001$. Both these tests indicate the set of items as at least adequately related for factor analysis. The analysis yielded three factors explaining 82% of the variance. However, for pragmatic reasons, supported by an internal consistency analysis (Cronbach's $\alpha = .885$ over all six items, no significant improvement by deleting items), factors 1 and 3 were combined. Factor 1 relates to organisational social influences. Factor 2 relates to social influences from co-habitants.

**Table G1**

*Factor Analysis Table for Social Influences on OSB*

| Item | Loadings | | | |
|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Communality |
| Colleagues are exemplary | .855 | | | .747 |
| Support by managers | .852 | | | .811 |
| Managers are exemplary | .841 | | | .786 |
| Support by colleagues | .834 | | | .717 |
| Information from organisation | | | .944 | .924 |
| Support from organisation | .421 | | .839 | .883 |
| Co-habitants are exemplary | | .909 | | .838 |
| Support by co-habitants | | .908 | | .827 |
| Eigenvalue | 3.810 | 1.055 | 1.669 | |
| % of total variance | 47.628 | 13.185 | 20.858 | |
| Total variance | | | 81.671% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix H

## Principal Component Factor Analysis of Factors Related to Sedentary Breaks

Eight items related to taking sedentary breaks were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table H1). All communalities were above .3, indicating each item sharing some common variance with other items. Likewise, the Kaiser-Meyer-Olkin measure of the sampling adequacy was .71, above the recommenced value of .6. Bartlett's test of sphericity was significant: $\chi^2(28) = 216.76$, $p < .001$. Both these tests indicate the set of items as at least adequately related for factor analysis. The analysis yielded three factors explaining 67% of the variance. Factor 1 relates to working activity, factor 2 relates to personal motivation, and factor 3 relates to organisational influences.

**Table H1**

*Factor Analysis Table for Factors Related to Sedentary Breaks*

| Item | Loadings | | | |
|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Communalities |
| Enough energy | .853 | | | .767 |
| Enough time | .816 | | | .697 |
| Too much stress | -.784 | | | .653 |
| Seeing co-habitants | .569 | | | .340 |
| Priority | | -.851 | | .747 |
| Motivation | | -841 | | .741 |
| Organisational encouragement | | | .841 | .746 |
| Information from organisation | | | .752 | .669 |
| Eigenvalue | 2.861 | 1.313 | 1.188 | |
| % of total variance | 35.762 | 16.406 | 14.850 | |
| Total variance | | | 67.018% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix I

## Principal Component Factor Analysis of Changes in Work Aspects since COVID-19 Regulations-Related Working From Home

Nine items related to experienced changes in work aspects were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table I1). All communalities were above .3, indicating each item sharing some common variance with other items. The Kaiser-Meyer-Olkin measure of the sampling adequacy was .59, just below the recommenced value of .6. However, Bartlett's test of sphericity was significant: $\chi^2(36) = 198.61$, $p < .001$. With some reserve, there is some indication for the set of items as just adequately related for factor analysis. The analysis yielded three factors explaining 61% of the variance; however, two of the three items of the third factor loaded also on the first factor and were thus kept separately. Factor 1 relates to working pressure, while factor 2 relates to communication.

**Table I1**

*Factor Analysis Table for Experienced Changes in Work Aspects*

| Item | Loadings | | | |
|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Communality |
| Working hours | .816 | | | .699 |
| Workload | .799 | | | .658 |
| Number of breaks | -.594 | | | .375 |
| Communication with management | | .826 | | .683 |
| Communication with colleagues | | .817 | | .685 |
| Communication with others worked with | | .593 | | .495 |
| Satisfaction in work | | | -.733 | .565 |
| Duration of tasks | .325 | | .696 | .590 |
| Distractions from work | -.403 | | .692 | .703 |
| Eigenvalue | .2.286 | 1.670 | 1.497 | |
| % of total variance | 25.404 | 18.556 | 16.628 | |
| Total variance | | | 60.588% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix J

## Principal Component Factor Analysis of Experienced Consequences of Work Aspects Since COVID-19 Regulations-Related Working From Home

Ten items related to experienced consequences of work aspects were analysed using principal component analysis with Varimax (orthogonal) rotation (see Table J1). Most communalities were above .3, indicating each item sharing some common variance with other items. Likewise, the Kaiser-Meyer-Olkin measure of the sampling adequacy was .77, above the recommenced value of .6. Bartlett's test of sphericity was significant: $\chi^2(28) = 286.83$, $p < .001$. Both these tests indicate the set of items as at least adequately related for factor analysis. The analysis yielded two factors explaining 57% of the variance. Factor 1 relates to communication. The items loading in factor 2 were logically consistent with a relation between well-being and work performance.

**Table J1**

*Factor Analysis Table for Experienced Consequences of Work Aspects*

| Item | Loadings | | |
|---|---|---|---|
| | Factor 1 | Factor 2 | Communality |
| Communication with management | .860 | | .741 |
| Communication with others worked with | .829 | | .696 |
| Communication with colleagues | .812 | .382 | .806 |
| Social and mental well-being | | .738 | .620 |
| Ability to do the job | | .715 | .596 |
| Physical well-being | | .621 | .394 |
| Effectiveness of work | | .621 | .445 |
| Workload | | .486 | .254 |
| Eigenvalue | 3.262 | 1.290 | |
| % of total variance | 40.771 | 16.125 | |
| Total variance | | 56.896% | |

*Note.* Factor loadings < .3 are suppressed.

# Appendix K

## Distribution of Sitting Times During Workhours in Minutes

**Figure K1**

*Histogram of Distribution of Sitting Time During Workhours in Minutes*

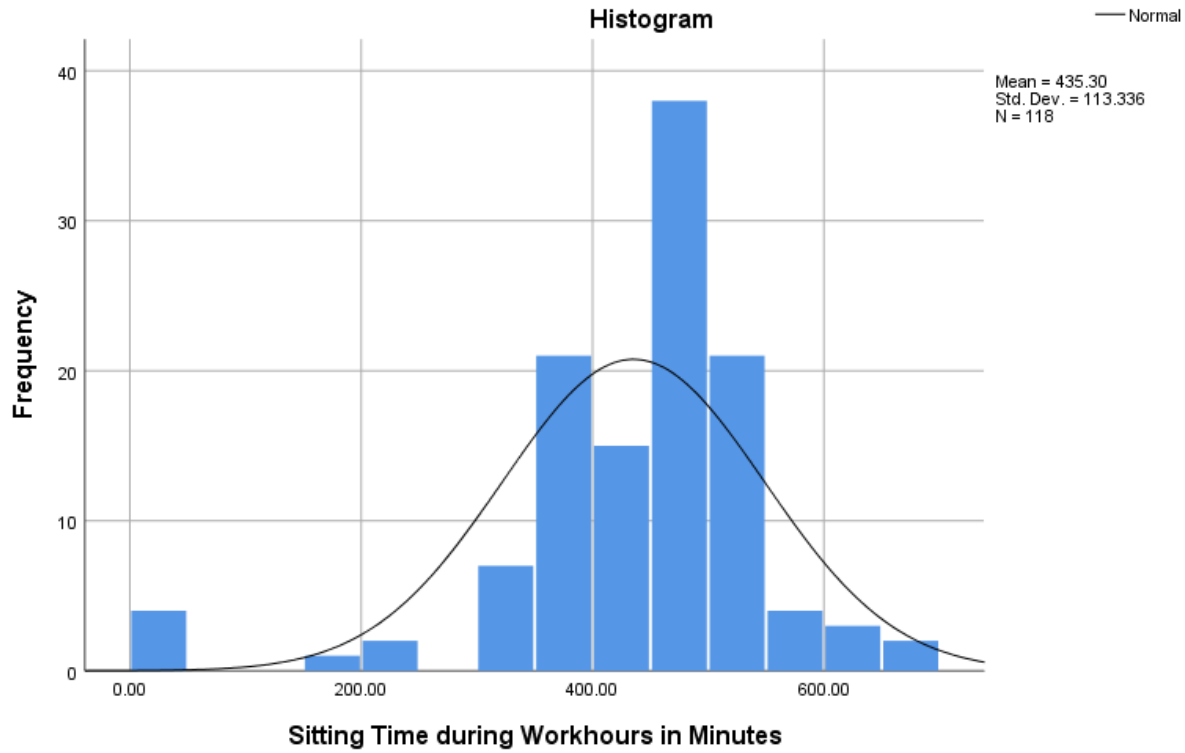



**Figure K2**

*Q-Q Plot of Distribution of Sitting Time During Workhours in Minutes*