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**Centro Universitário de Lisboa**

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**Mestrado em Exercício e Bem-Estar**

# PARTICIPANTS' PERCEPTIONS OF INTERVENTIONS USING SIT-STAND DESKS

Dissertação apresentada a provas públicas para a obtenção do Grau de Mestre em Exercício e Bem-Estar presidida por Professora Doutora Marlene Nunes da Silva, arguida por Professor Doutor António João Labisa da Silva Palmeira e orientada por Prof. Doutor Pedro Alexandre Barracha Da Guerra Júdice

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# PARTICIPANTS' PERCEPTIONS OF INTERVENTIONS USING SIT-STAND DESKS

## "VERSÃO FINAL"

Dissertação defendida em provas públicas na Universidade Lusófona, Centro Universitário de Lisboa no dia 22/11/2024, perante o júri, nomeado pelo Despacho de Nomeação Nº1044/2024, de 12 de Novembro de 2024, com a seguinte composição:

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Orientador: Prof. Doutor Pedro Alexandre Barracha Da Guerra Júdice

**Lisboa**

**2024**

*Sitting is the new smoking.*

Dr. James Levine

Ao meu avô, pelo exemplo que é para mim, e por fomentar em mim a busca pelo conhecimento.

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À minha mãe, ao meu pai, à minha irmã e à Bonnie, por serem a minha base, me acompanharem e apoiarem nesta jornada académica.

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## Resumo geral

**Objetivo:** A presente dissertação apresenta dois objetivos principais: 1- Realizar uma revisão sistemática no sentido de reunir e analisar a mais recente evidência face às perceções dos participantes de intervenções com utilização de sit-stand desks (SSDs), identificando barreiras e facilitadores à sua utilização; 2- Avaliar as perceções dos participantes da intervenção SUFHA (Stand Up for Healthy Aging) relativamente à sua experiência com utilização das SSDs, focando as barreiras e facilitadores reportadas e comparando os resultados com o que a evidência tem demonstrado.

**Método:** Foi realizada uma pesquisa em três bases de dados (PubMed, B-On e SportDiscus) até 7 de dezembro de 2023 na procura de estudos que apresentassem dados qualitativos de intervenções envolvendo utilização de SSDs no local de trabalho. Para cada estudo, foram recolhidas informações sobre as descrições das intervenções, métodos de recolha de dados e análise de dados. Uma análise temática foi realizada para identificar os temas mais frequentemente mencionados pelos participantes, utilizando o modelo socio-ecológico para os organizar em três níveis específicos, categorizando-os por fim como barreiras e/ou facilitadores. O estudo original tratou-se de uma análise qualitativa do estudo SUFHA, utilizando uma amostra de dezanove participantes, dos quais foram recolhidas perceções sobre o uso das SSDs através de questionários de satisfação mensal e entrevistas semiestruturadas. Foi realizada uma análise qualitativa das variáveis dos questionários, juntamente com uma análise temática das entrevistas semiestruturadas, com o objetivo de identificar as principais barreiras e facilitadores à utilização de SSDs.

**Resultados:** Da análise temática realizada aos 14 estudos da revisão sistemática resultaram 12 temas mais mencionados pelos participantes: "Health risks", "SSDs Caractheristics" e "Acess" como barreiras, enquanto "Health benefits", "Supporting factors" e "Social support" foram reconhecidos como facilitadores do uso das SSDs. Temas como "Habit", "Knowledge", "Work routine" e "Workplace norms/culture" mostraram-se como barreiras e facilitadores, dependendo do contexto específico. Os participantes do estudo SUFHA relataram que as secretárias eram fáceis de utilizar, ajudavam a criar novos hábitos e que gostariam de continuar a usar no futuro. Foram relatadas melhorias posturais e alívio do desconforto músculo-esquelético, embora alguns participantes tenham experienciado desconforto lombar e fadiga nas pernas e pés. Os participantes relataram também que a utilização das SSDs variava dependendo da carga de trabalho e do tipo de tarefa. Muitos relataram limitações no design

das secretárias, especificamente em relação ao espaço da plataforma e ao mecanismo de ajuste de altura, levando a desconforto nos ombros, cotovelos e pulsos.

**Conclusões:** Os resultados do estudo original vão de encontro com o que a revisão sistemática demonstrou, confirmando a aceitação dos participantes face à utilização de SSDs no local de trabalho como forma de reduzir o comportamento sedentário. Abordagens futuras devem ter em conta o design das SSDs, garantindo que esta seja funcional e não prejudique a saúde dos trabalhadores. Devem desta forma considerar as barreiras e facilitadores mais reportados na evidência para desta forma melhorar a experiência de utilização das SSDs e fomentar uma cultura de saúde e bem-estar no local de trabalho.

**Palavras-chave:** secretárias ajustáveis em altura, perspetivas dos participantes, local de trabalho, barreiras, facilitadores.

## General Abstract

**Objective:** This dissertation has two main goals: 1- To conduct a systematic review to gather and analyze the most recent evidence regarding participants' perceptions of interventions using sit-stand desks (SSDs), identifying barriers and facilitators to their use; 2- To assess participants' perceptions of the SUFHA (Stand Up for Healthy Aging) intervention regarding their experience using SSDs, focusing on the reported barriers and facilitators, and comparing the results with the evidence demonstrated.

**Method:** A search was conducted in three databases (PubMed, B-On, and SportDiscus) until December 7, 2023, to find studies presenting qualitative data on interventions involving the use of SSDs in the workplace. For each study, information was collected on the descriptions of the interventions, data collection methods, and data analysis. A thematic analysis was performed to identify the themes most frequently mentioned by participants, using the socio-ecological model to organize them into three specific levels, and finally categorizing them as barriers and/or facilitators. The original study was a qualitative analysis of the SUFHA study, using a sample of 19 participants, from whom perceptions about the use of SSDs were collected through monthly satisfaction questionnaires and semi-structured interviews. A qualitative analysis of the questionnaire variables was conducted, along with a thematic analysis of the semi-structured interviews, with the aim of identifying the main barriers and facilitators to the use of SSDs.

**Results:** The thematic analysis of the 14 studies from the systematic review revealed 12 themes most frequently mentioned by participants: "Health risks," "SSD Characteristics," and "Access" as barriers, while "Health benefits," "Supporting factors," and "Social support" were recognized as facilitators of SSD use. Themes such as "Habit," "Knowledge," "Work routine," and "Workplace norms/culture" emerged as both barriers and facilitators, depending on the specific context. Participants in the SUFHA study reported that the SSDs were easy to use, helped create new habits, and that they would like to continue using them in the future. Postural improvements and relief from musculoskeletal discomfort were reported, although some participants experienced lower back discomfort and leg and foot fatigue. Participants also reported that the use of SSDs varied depending on workload and task type. Many reported limitations in the desk design, specifically related to the platform space and the height adjustment mechanism, leading to discomfort in the shoulders, elbows, and wrists.

**Conclusions:** The results of the original study align with the findings of the systematic review, confirming participants' acceptance of the use of SSDs in the workplace as a way to reduce sedentary behavior. Future approaches should consider the design of SSDs, ensuring they are functional and do not compromise workers' health. Therefore, the most reported barriers and facilitators in the evidence should be taken into account to improve the experience of using SSDs and foster a culture of health and well-being in the workplace.

**Keywords:** sit-stand desks, participants' perspectives, workplace, barriers, facilitators.

## List of Abbreviations

**CS -** Comportamento sedentário

**PA -** Physical activity

**SB -** Sedentary behavior

**SSD** - Sit-stand desks

**SUFHA -** Stand Up For Healthy Aging

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# CHAPTER I

## General Introduction

The rapid industrialization, technological advances, and urbanization have led to economic growth and better living standards. However, these shifts have also resulted in more sedentary office jobs, increasing sitting time and reducing physical activity (Dunstan et al., 2010; Owen et al., 2010; Sallis et al., 2016)

Evidence has shown that prolonged sitting during work is associated with higher risks of type 2 diabetes, cardiovascular disease, and mortality (Wilmot et al., 2012). Given this reality, it becomes evident that workplaces are key for promoting health by addressing sedentary behavior (World Health Organization, 2018).

Recent research highlights the use of active workstations, such as sit-stand desks, to promote movement during work hours. These desks aim to reduce sitting and encourage posture changes, mitigating the negative effects of prolonged sitting by alternating between sitting and standing helping lessen the negative health effects of prolonged sitting (Buckley et al., 2015; Hadgraft et al., 2021).

Studies have examined the impact of sit-stand desks on office workers' behavior and health, investigating variables like sitting/standing durations (Arguello et al., 2023), cardiometabolic health (Bodker et al., 2021), energy expenditure (Burns et al., 2017), and work engagement (Weatherson et al., 2020). Evidence supports the effectiveness of sit-stand desks in improving participants' health and productivity (Ma et al., 2021; Pereira et al., 2020) however more qualitative research is needed to understand participants experiences regarding sit-stand desks use (Nooijen et al., 2018).

This present work aims to analyze the most recent evidence regarding interventions involving the use of sit-stand desks through the development of a systematic review and the production of an original article based on a clustered randomized controlled trial. Through a systematic review, the goal is to gather and examine articles that present a qualitative or mixed-methods approach, focusing on participants' perceptions about sit-stand desk interventions. This will provide a deeper understanding of the main barriers and facilitators to the use of sit-stand desks. The aim of the original article aligns with the fact that there are no qualitative studies on interventions using sit-stand desks conducted in Portugal. Therefore, a qualitative analysis of the SUFHA study is intended to examine the testimonies of participants who used sit-stand desks, identifying the main barriers and facilitators to their use. Finally,

the last chapter will integrate the findings from both the systematic review and the original study aiming to assist researchers establishing and planning future sit-stand desk based interventions to improve its acceptability and concurrent effectiveness.

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# CHAPTER II

## Barriers and facilitators of workplace sit-stand desk-based interventions: a qualitative systematic review

## Resumo

**Objetivo:** Para melhorar os resultados de saúde, as sit-stand desks (SSDs) têm sido reconhecidas como uma estratégia eficaz para reduzir o comportamento sedentário (CS) no local de trabalho. No entanto, há uma falta de conhecimento sobre as experiências dos utilizadores com estas intervenções. A presente revisão sistemática teve como objetivo compilar os mais recentes dados qualitativos dos participantes sobre a aceitação das intervenções com SSDs, identificando barreiras e facilitadores à sua utilização.

**Métodos:** Foram pesquisadas três bases de dados eletrónicas (PubMed, B-On e SportDiscus) até 7 de dezembro de 2023. Recolheram-se informações sobre a descrição das intervenções, métodos de recolha e análise de dados. A análise temática identificou temas recorrentes, organizados utilizando o Modelo Socioecológico, e depois categorizados como barreiras e facilitadores à utilização das SSDs.

**Resultados:** Foram incluídos catorze estudos. A análise temática identificou doze temas relacionados com as experiências dos participantes com as SSDs. A maioria dos estudos mencionou "Health risks", "SSDs caractheristics" e "Acess" como barreiras, enquanto "Health benefits", "Supporting factors" e "Social support" foram reconhecidos como facilitadores.

**Conclusões:** Esta revisão concluiu que os participantes, de forma geral, acolheram bem as SSDs como uma forma de reduzir o CS. Os principais fatores motivadores incluíam os benefícios para a saúde e o apoio de colegas e supervisores, enquanto as principais barreiras estavam relacionadas com desconforto músculo-esquelético e o design específico das SSDs. Intervenções futuras devem considerar e abordar estas barreiras para melhorar a experiência de utilização das SSDs e promover ambientes de trabalho mais saudáveis.


**Palavras-chave:** secretárias ajustáveis em altura, comportamento sedentário, local de trabalho, perspetivas dos participantes, barreiras, facilitadores.

## Abstract

**Purpose:** To improve health outcomes, sit-stand desks have been recognized as an effective strategy for reducing sedentary behavior in the workplace. However, there's a lack of knowledge on users' experiences with these interventions. The current systematic review aimed to compile recent qualitative insights from participants on the acceptability of sit-stand desk interventions, identifying barriers and facilitators for their use.

**Methods:** Three electronic databases (PubMed, B-On, and SportDiscus) were searched until December 7th, 2023. Information on intervention description, data collection methods and analysis were gathered. Thematic analysis identified recurring themes, organized using the Socio-Ecological Model, and then categorized into barriers and facilitators to sit-stand desk utilization.

**Results:** Fourteen studies were included. Thematic analysis identified twelve themes related to participants' experiences with sit-stand desks. Most studies cited "Health risks", "Sit-stand desk characteristics", and "Access" as barriers, while "Health benefits", "Supporting factors", and "Social support" were facilitators.

**Conclusions:** This review found that participants generally welcomed sit-stand desks to reduce sedentary behavior. Key motivators included health benefits and support from colleagues and managers, while primary barriers were musculoskeletal discomfort and specific desk designs. Future interventions must consider and address these barriers to improve the sit-stand desk experience and promote healthier workplace environments.

**Keywords:** sit-stand desks, sedentary behavior, workplace, participants' perspectives, barriers and facilitators.

## II.1 Introduction

The rapid processes of industrialization, technological advancement, and urbanization have resulted in substantial economic growth, heightened productivity, and enhanced living standards. However, these developments have also brought significant lifestyle changes, primarily characterized by a transition to more sedentary office-based occupations, leading to increased sedentary behavior (SB) and reduced physical activity (Dunstan et al., 2010; Owen et al., 2010; Sallis et al., 2016).

SB is defined as waking time spent sitting or lying with low energy expenditure (≤1.5 metabolic equivalents) and occupies a large proportion of waking hours (up to 80%) across multi-faceted environments (e.g., home, work, school, transport) (Tremblay et al., 2017). Extended periods of SB during occupational activities have been linked to increased risks of various health outcomes, such as type 2 diabetes, cardiovascular disease, morbidity, and mortality (Wilmot et al., 2012). A considerable portion of SB is accrued during extended periods of office work, with estimates suggesting that approximately 82% of office-related tasks involve sedentary activities (Parry & Straker, 2013).

Physically inactive is the term most used to characterize those not achieving the minimum recommendations of moderate-to-vigorous intensity physical activity (PA) (150 minutes of moderate intensity aerobic PA or 75 minutes of vigorous intensity aerobic PA, per week). Global estimates indicate that 27.5% of adults do not meet these recommendations and four to five million deaths per year could be averted if the global population was more physically active (Bull et al., 2020).

The workplace has been highlighted as a vital setting for health promotion through actions to reduce SB (World Health Organization, 2018). Hence, it is imperative to implement focused initiatives aimed at addressing SB and reducing prolonged bouts of sitting time in the workplace, to achieve improved health outcomes (Shrestha et al., 2016). Recent research has shown interest in specific interventions utilizing active workstations within the office environment, to promote PA during working hours (Lam et al., 2022; Nguyen et al., 2020). Options like sit-stand workstations, treadmill workstations, and cycling workstations have been implemented (Dupont et al., 2019; MacEwen et al., 2015; Scisco et al., 2023).

Sit-stand desks (SSDs) have been implemented in numerous interventions with the aim of decreasing SB during working hours and fostering regular changes in posture (Brown et al., 2022; Daneshmandi et al., 2021). The underlying rationale is that introducing variations

in posture and incorporating opportunities for standing may help alleviate the adverse effects of prolonged SB on overall health (Buckley et al., 2015; Hadgraft et al., 2021). Recent studies have undertaken analyses to examine the impact of SSDs on behavioral and health outcomes among office workers (Russo et al., 2021; Zhu et al., 2020). Examples of variables investigated include sitting and standing bouts (Arguello et al., 2023), cardio metabolic health (Bodker et al., 2021), energy expenditure (Burns et al., 2017), work engagement and occupational fatigue improvements (Weatherson et al., 2020), and psychological symptoms (Konradt et al., 2020), amongst others. Evidence has shown effectiveness of a SSDs in reducing SB and improving workers' health and productivity (Ma et al., 2021; Pereira et al., 2020; Wilkerson et al., 2023). However, there is a lack of information collected about detailed qualitative data, evaluating users experiences and perspectives related to SSDs (Nooijen et al., 2018).

The aims of this systematic review are to gather the most recent qualitative findings from studies that specifically address SSDs interventions and identify the barriers and facilitators associated with using these types of workstations.

## II.2 Methods

The current Systematic Review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021) and it was prospectively registered (ID-CRD42024497102) with the International Prospective Register of Systematic Reviews (PROSPERO).

### *Search strategy and study selection*

Three electronic databases (PubMed, B-On, and SportDiscus) were used to conduct the research on December 7th, 2023. The research strategy aimed to encompass the term "Sit-stand desks" and its synonyms, and on the other hand, to characterize the desired study type through "qualitative analysis". In this manner, the search terms employed were: ("Sit-stand desks" OR "sit-stand workstation" OR "height adjustable desk" OR "height adjustable workstation") AND "qualitative analysis".

**Table 1- Search Strategy and Eligibility Criteria based on the SPIDER Acronym (Table based on Compernolle et al. (2020))**

| SPIDER | Description |
|---|---|
| **Sample** | Office workers who have had the experience of using SSDs |
| **Phenomenon of Interest** | Usage of SSDs |
| **Design** | Focus groups/ interviews and/or questionnaire from RCT's or intervention studies' participants |
| **Evaluation** | Perceptions of the use of SSDs by office workers |
| **Research** | Qualitative and mixed-methods studies |

The eligibility criteria were formulated using the Sample, Phenomenon of Interest, Design, Evaluation, and Research type (SPIDER) tool, as seen in Table 1. This tool serves as an alternative to the PICO approach and it has been made for qualitative syntheses (Compernolle et al., 2020). A preliminary search was conducted to assess the volume of evidence regarding qualitative studies related to the use of SSDs. A significant portion of the identified studies were randomized controlled trials aimed at evaluating the impact of SSDs on variables related to SB but lacked results pertaining to qualitative analysis. Consequently, it was observed that there were a limited number of studies in this area, leading to the initial establishment of few eligibility criteria. For this stage of the data extraction in the systematic review, two researchers were involved (MPP and PBJ). After the search was done by MPP, articles were filtered by Title, Abstract and full text analysis. Subsequently, researcher PBJ conducted the same analysis. Following this, divergences were followed by a discussion to determine the reasons for the inclusion and exclusion of each article, resulting in a final number of articles to be included. The search was conducted using the aforementioned terms, with the additional filters of "articles published in the last ten years" and "full text available." The inclusion criteria were: articles related to experiences with the use of SSDs; articles mentioning qualitative analysis, qualitative approach, or qualitative study; articles addressing user perspectives or user experiences using SSDs; articles reporting interviews, testimonials,

or questionnaires conducted with participants regarding the use of SSDs. The exclusion criteria for this review were: articles not written in English and articles focusing solely on quantitative data analyses of SSD interventions.

***Quality assessment***

The methodological quality of the included studies was assessed by the Critical Appraisal Skills Programme Qualitative Checklist (CASP) (*Critical Appraisal Skills Programme,* 2018). This 10-item quality assessment tool is frequently used in systematic reviews of qualitative evidence. Studies were deemed 'high quality' if they satisfied at least 8 out of the 10 criteria, 'medium quality' if they met 5–7 of the criteria, and 'low quality' if they met 4 or fewer. Quality assessment of the included studies was conducted independently by two researchers (MPP and SF) and any doubts in the assessments were resolved through consultation with another researcher (PBJ).

***Data synthesis and analysis***

The results from each eligible study were analyzed using Thematic Analysis, with the aim of identifying the emerging themes, comprehending testimonies regarding the perceptions of the use of SSDs by participants. The initial analysis corresponded to Thematic Synthesis, which comprises a 3-step approach described by Thomas and Harden (Thomas & Harden, 2008), that allows for transparent summarizing of existing qualitative evidence and enables the generation of new interpretive constructs, explanations, and hypothesis (Compernolle et al., 2020). This process was carried out independently by two researchers (MPP and SF), with differences being resolved through discussion with a third researcher (PBJ). The first line-by-line coding was performed manually by one researcher (MPP), identifying, and recording the most emergent themes in the results of each study. Simultaneously, another researcher (SF) conducted the same analysis using NVivo software (NVivo Windows® (Release 1.7.2)). The results from each study were imported into the software and were then coded line by line, resulting in a presentation of the generated themes, the number of their occurrences in the studies, as well as in how many studies they appear. In a second phase, instead of using the third step related to Thematic Synthesis, the Socio-Ecological Model of SB was used (Owen et al., 2011). This model comprises the intrapersonal level (individual's beliefs, attitudes, behaviors), interpersonal level (social factors), and environmental level (workplace culture, environment), that were used to categorize the verified themes and to group the barriers and facilitators regarding the use of SSDs.

## II.3 Results

### *Literature search process*

Figure 1 illustrates the entire selection and search process, including the total number of excluded studies and the reasons for their exclusion. Initially, two hundred and fifteen (215) studies were found through the database search. Out of these two hundred and fifteen (215), three (3) duplicates were identified and removed. Among the remaining two hundred and twelve (212) studies, one hundred and seventy six (176) were excluded based on title and abstract, and an additional twenty two (22) were excluded after a full-text reading. Consequently, fourteen (14) studies were included in the present systematic review.

### *Study characteristics*

Characteristics of the included studies are displayed in Table 2. Of the included studies, five were conducted in Australia, four in the United Kingdom, two in the United States of America, two in the Netherlands and one in South Africa. Seven studies used a qualitative methodology only and seven used a mixed-method design. Sample sizes ranged from 11 to 1098 participants, and the mean age of the participants varied from 25 to 64 years. Data was collected through: semi-structured (individual or group) interviews (n=8); focus groups (n=6); open- ended/close-ended survey (n=4); structured interviews (n=1) and 19 item 5-point Likert scale questionnaire (n=1). Data was analyzed using: thematic analysis (n=7); thematic analysis plus grounded theory analysis (n=3); thematic analysis plus content theory analysis (n=1); thematic (template) analysis (n=1); thematic analysis plus APEASE criteria (n=1) and grounded theory plus logistic regression analysis (n=1).

### *Quality appraisal of included studies*

The detailed outcomes of the appraisal of each study are delineated in Table 3. Succinctly, all studies were appraised as "high quality" despite some of the criteria lacking sufficient information in certain studies. The categories in which most studies exhibited deficiencies were the study design (attributed to inadequate justification for the design) and the relationships category (due to the lack of consideration, or lack of description, of the researcher–participant relationship).

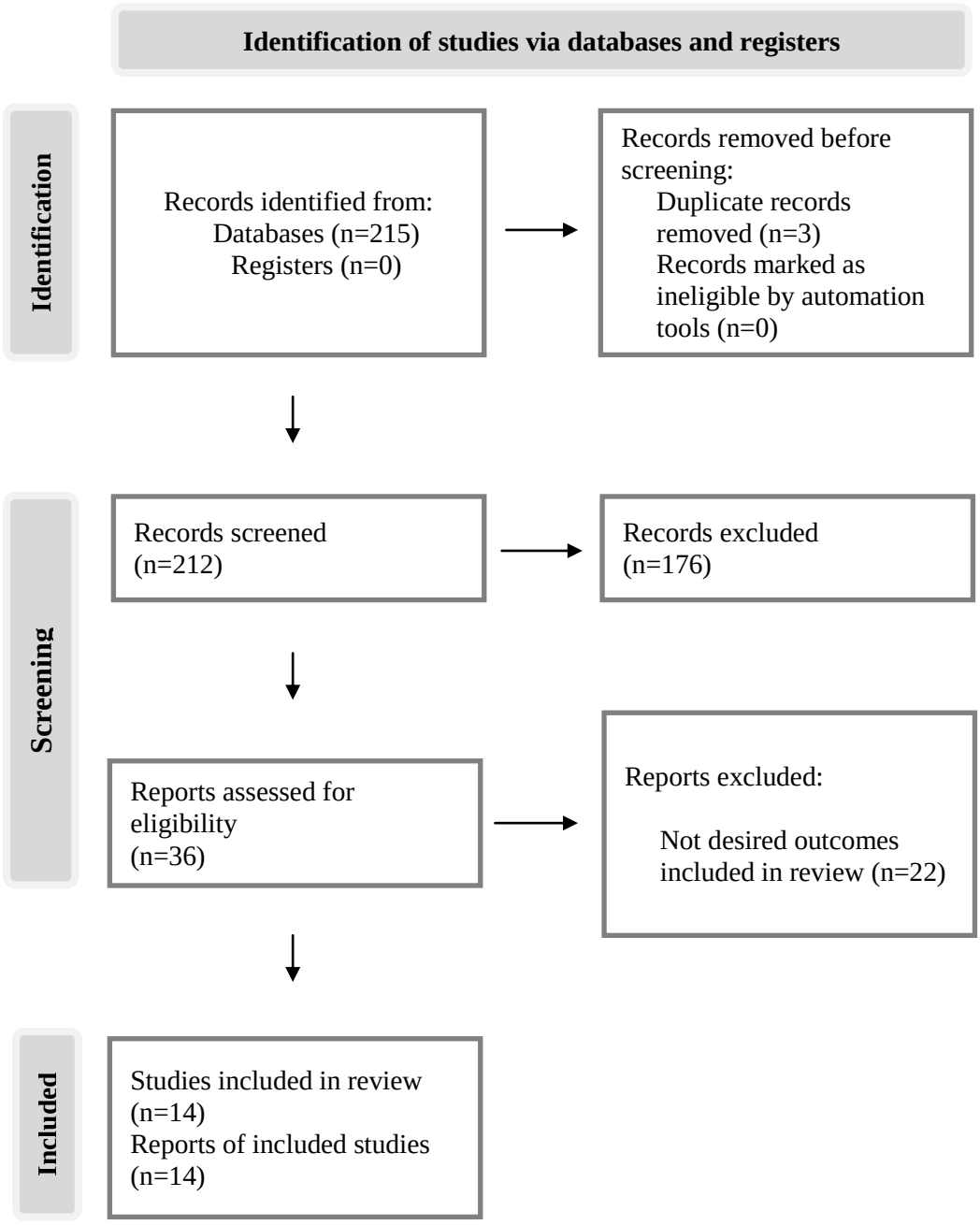


**Figure 1-** PRISMA flow diagram depicting the process of study selection. n = number of articles (Based on Page et al. (2021)).

**Table 2 - Studies' Main Characteristics** (Table based on Compernolle et al. (2020))

| Source Characteristics | Research aims | Study Design | Sample Characteristics | Data collection method | Data analysis |
|---|---|---|---|---|---|
| (author, year of publication, country) | | qualitative or mixed-method study | (sample size, mean age (±SD), gender, healthy vs clinical populational | (unstructured interview, semistructured interview of focus group) | (content analysis, grounded theory analysis, thematic analysis, or other) |
| Wilkerson et al. (2019), United States of America | To use qualitative interviews to examine and describe barriers and facilitators that influence SSD use in the workplace setting among employees currently using a SSD | Qualitative | N=37; 42 (±11.99) years; 51% female; Staff paid monthly (54%) and highly educated (59%); 62% of participants (n=23) used a tabletop SSD that manually transitions between seated and standing position, 27% had a SSD that transitions | Semi-structured interviews | Thematic analysis |

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| | | | electronically and 11% had a permanent SSD | | |
| Henderson et al. (2018), Australia | To Investigate the experiences of workers who had previously used or were currently using a SSDs | Qualitative | N=24; Age range 25-64 years; 13(≈54%) female; 16(≈67%) employed full time; 22 current and ceased users, and two key informants volunteered to participate in the study | Semi-structured interviews | Thematic analysis |
| Chau et al. (2014), Australia | To qualitatively evaluate the acceptability, feasibility, and perceptions of using SSDs in a group of desk-based office workers in Sydney, Australia | Qualitative | N=42; 38(±11) years; 36(86%) female; 34(81%) working full time; 36(86%) work at an open office. 9 focus groups, each group had 4-5 participants; one person was interviewed individually as they were not able to attend a focus group. | Focus groups discussion | Thematic analysis |

| | | | | | |
|---|---|---|---|---|---|
| Brierley et al. (2022), United Kingdom | To use the APEASE criteria to assess the experiences of those who participated in a multi-component sedentary workplace intervention involving SSDs | Qualitative | N=13; 38(±10) years; 8 (62%) female; 85% having a university or higher degree. Participants worked an average of 34 (±9) hours per week. | Semi-structured interviews | Inductive approach- Thematic analysis<br>Deductive approach- APEASE criteria |
| Graves et al. (2015), United Kingdom | To evaluate changes in workplace sitting following installation of a SSD, compared to normal working conditions. (Qualitative analysis focused on the acceptability and feasibility of SSDs in a real office setting). | Mixed-method study | N=47; 38.6 ± 9.5 years; 37 (79%) female; 35(75%) work in the same space with more than 3 employees. Only 44 (23 intervention, 21 control) were assessed for change in workplace sitting time | 19-item five-point Likert scale questionnaire<br>Semi-structured focus groups | Content and Thematic Analysis |
| Dutta et al. (2015), United States of America | To report findings derived from a qualitative approach to understanding the | Qualitative | N=28; 40.4 (± 8.7) years; 36.8 (± 5.6) hours of work per week; 3 focus groups | Semi-structured focus groups<br>Structured interviews | Grounded theory analysis<br>Thematic analysis |

| | | | | | |
|---|---|---|---|---|---|
| | experience of transitioning from a traditional sitting workstation to the use of SSDs in a group of sedentary American office workers. | | | | |
| Gradidge et al. (2022), South Africa | To explore the perceptions of South African office workers towards using height-adjustable SSDs to reduce sitting time during vocational hours | Qualitative | N=11; 40.5 (± 12.6) years; 91% female; | Semi-structured interviews | Thematic analysis |
| Engelen et al. (2019), Australia | To assess the efficacy and acceptability of the co-designed multiple component "Move More, Sit Less" intervention in a 'real world' workplace | Mixed-method study | N=46 (30 intervention group and 16 control group); 63% were aged between 36 and 55 years; 25 male and 21 female; 100% working fulltime and 55% were | Open-ended survey | Thematic analysis |

| | | | | | |
|---|---|---|---|---|---|
| | setting. | | overweight or obese. Of the intervention participants, 87% had not previously had or used a SSD. | | |
| Renaud et al. (2018), Netherlands | To determine how often and how long the standing option is used and how the use of SSDs is perceived in office workers with long-term access to these workstations | Mixed-method study | N=1098; 46,5(± 7.8) years; 64,6% males; 38,6(± 6.1) work hours/week; 23% work at home at least 1 day/ week | Online close-ended answers survey | Grounded theory analysis<br>Logistic regression analyses |
| Edwardson et al. (2023), United Kingdom | 1. To describe the participant and workplace champion experiences of the SWAL intervention.<br>2. To explore whether experiences are different across the two intervention groups, | Mixed-method study | N=756 participants (78 Clusters), control (n=26 clusters, 267 participants), SWAL only (n=27, 249 participants) or SWAL plus desk (n=25, 240 participants). | Semi-structured individual interviews and focus groups<br>Open-ended and close-ended questions online survey | Thematic analysis<br>Grounded theory analysis |

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|---|---|---|---|---|---|
| | and gather insight into the reasons for the lack of behavior change outside of work hours | | | | |
| Hadgraft et al. (2017), Australia | To explore the acceptability of the intervention barriers and facilitators to reducing workplace sitting, and perceived effects of the intervention on workplace culture, productivity and health related outcomes. | Qualitative | Interview participants- N= 21; 48.9 (±8.5) years; 12 (57%) female<br>Focus group participants- N=7; 45.6 (±11.3) years; 6 (86%) female | Semi-structured focus groups<br>Semi-structured interviews | Thematic analysis |
| Biddle et al. (2020), United Kingdom | To present the process evaluation of the SMArT (Stand More at Work) intervention. | Mixed-method study | Survey participants-<br>At 6 months- N=58 (88% of intervention participants); age 42.4 ± 11.3 years; 74% female; BMI 25.8 ± 5.0 kg/m2; at 12 months- N=55 | Semi-structured focus groups<br>Open-ended and close-ended questions survey | Thematic (template) analysis |

| | | | | | |
|---|---|---|---|---|---|
| | | | (87% of intervention participants); age 43.0 ± 10.8 years; 71% female; BMI 26.0 ± 5.3 kg/m2;)<br><br>Focus groups participants- N= 29 (46% of intervention participants); age 41.1 ± 12.2 years; 72% female; BMI 26.1 ± 5.6 kg/m2 | | |
| Renaud et al. (2020),<br><br>Netherlands | 1.To explore the reasons for use and non-use of SSDs<br><br>2. To explore other strategies to decrease sitting and increase PA in the workplace | Qualitative | N=31; 49.1 (± = 5.4) years; 65% male. | Semi-structured group interviews | Thematic analysis |
| Grunseit et al. (2013),<br><br>Australia | To evaluate the acceptability and usability of manually and electrically | Mixed-method study | N=19; aged 27-59 years (median 46 years); 53% were female (N=10); almost 80% had a | Semi-structured individual and group | Thematic analysis<br><br>Grounded theory analysis |

| | | | | | |
|---|---|---|---|---|---|
| | operated SSDs in a medium-sized government organization located in Sydney, Australia | | tertiary education (n=15); worked full-time(n=18) | Interviews | |

**Table 3 - Quality Appraisal of included studies assessed by the Critical Appraisal Skills Programme (CASP) Qualitative Checklist (*Critical Appraisal Skills Programme*, 2018)**

| Study | Aims | Method | Design | Recruitment | Data collection | Relationships | Ethical issues | Analysis | Findings | Value of research | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wilkerson et al. (2019) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Henderson et al. (2018) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Chau et al. (2014) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Brierley et al. (2022) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Graves et al. (2015) | Yes | Yes | Can't Tell | Yes | Yes | Can't Tell | Yes | Can't Tell | Yes | Yes | Medium |
| Dutta et al. (2015) | Yes | Yes | Can't Tell | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Gradidge et al. (2022) | Yes | Yes | Can't Tell | Yes | Yes | Can't Tell | Yes | Can't Tell | Can't Tell | Yes | Medium |
| Engelen et al. (2019) | Yes | Yes | Yes | Yes | Can't Tell | Can't Tell | Yes | Can't Tell | Can't Tell | Yes | Medium |
| Renaud et al. (2018) | Yes | Yes | Can't Tell | Yes | Can't Tell | Can't Tell | Yes | Can't Tell | Yes | Yes | Medium |
| Edwardson et al. (2023) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Hadgraft et al. (2017) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | High |
| Biddle et al. (2020) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |
| Renaud et al. (2020) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | High |
| Grunseit et al. (2013) | Yes | Yes | Yes | Yes | Yes | Can't Tell | Yes | Yes | Yes | Yes | High |

### *Thematic analysis*

After analyzing the results from the fourteen (14) studies using the coding line by line, twenty one (21) emerging themes were identified initially. Researchers (MPP and SF) met to reach a consensus on the identified themes, reducing the number to fifteen (15). Following discussion with another researcher (PBJ), a total of twelve (12) descriptive themes were agreed upon: Acceptability; Access to SSDs; Habit; Health benefits; Health risks; Knowledge; Motivations; SSDs characteristics; Social support; Supporting factors; Work routine and Workplace norms/culture.

This thematic analysis made in NVivo software, reflects the line-by-line coding carried out for the participants' testimonies from the 14 studies in this review. In Table 4, it is possible to see the number of files and references for each theme found in the participants' testimonies. The files reflect the number of studies that mentioned the theme, while the references show the number of times each theme was mentioned.

#### *Intrapersonal level*

***Acceptability.*** This theme refers to how participants perceived the experience of using SSD during the study period. One factor mentioned by some participants in one study was the duration of the experience/intervention (in this case, 8 weeks), which was deemed appropriate for them to adjust to interrupting sitting time and increasing SSD usage (Owen et al., 2011). Some participants reported considering the experience of using SSDs positive; however, the loss of functionality in the workplace was identified as a challenge (Henderson et al., 2018), with some suggesting another model of SSD could be easier to use (Chau et al., 2014). On the other hand, some participants were surprised by how much they enjoyed using the SSDs, as well as the freedom of movement it allowed (Brierley et al., 2022), with some users noting an increase in productivity resulting from this innovative initiative in the workspace (Gradidge et al., 2022). Overall, participants showed acceptance of the experience of using SSDs, describing it as a positive intervention in the workplace (Engelen et al., 2019), easy to use (Graves et al., 2015), and something they would like to maintain for the future (Brierley et al., 2022).

***Habit.*** This theme reflects habit as a factor that somehow conditioned the use of SSDs. It relates both to the difficulty of changing established habits in the workplace as well as the need to create new habits that encouraged the use of the SSDs. Some participants noted

**Table 4 - Results of Thematic Analysis through the coding of participants' testimonies from each study**

| Themes | Files | References |
|---|---|---|
| Work routine | 12 | 38 |
| SSDs characteristics | 12 | 25 |
| Habit | 12 | 22 |
| Knowledge | 11 | 20 |
| Workplace norms/culture | 10 | 39 |
| Health benefits | 10 | 29 |
| Health risks | 10 | 25 |
| Social support | 10 | 21 |
| Supporting factors | 9 | 17 |
| Access to SSDs | 6 | 10 |
| Acceptability | 6 | 9 |
| Motivations | 6 | 6 |

difficulties in using the SSD due to the ingrained habit of sitting (Wilkerson et al., 2019), reflecting the routine developed over several years of seated work. The forgetfulness factor was also frequently mentioned, in the sense that although they were provided with SSDs in the workplace intervention, for some participants, having the equipment was not enough to break the habits already established (Edwardson et al., 2023; Graves et al., 2015; Renaud et al., 2018; Wilkerson et al., 2019). In contrast, others revealed that the presence of SSDs was sufficient to reduce their sitting time (Biddle et al., 2020; Brierley et al., 2022), as they adopted new habits and routines that allowed them to spend more time standing, which was seen by many as a personal motivation (Chau et al., 2014). For some participants, there was a higher use of SSDs at the beginning of the interventions with a subsequent gradual decline (Graves et al., 2015). It was also noted by some that they tended to use the SSD more in the morning when they were more active and enthusiastic, with usage declining as the day progressed (Gradidge et al., 2022; Henderson et al., 2018). The intervention, for some, served to change their perception of standing, a view that was transferred to daily life habits, such as in public transportation, modifying the desire and need to sit (Chau et al., 2014).

***Health benefits.*** Several participant testimonies were identified regarding health benefits. Changes related to fatigue, disposition, cognitive ability, posture, and

musculoskeletal problems were reported. During the intervention with the use of SSDs, a perceived decrease in fatigue and boredom was noted , resulting in a state defined by many as "having more energy" (Biddle et al., 2020; Brierley et al., 2022; Dutta et al., 2015). Participants reported a positive impact of increased standing time (standing time) on cognitive abilities such as focus, alertness, productivity, concentration, and confidence in work (Biddle et al., 2020; Chau et al., 2014; Edwardson et al., 2023; Renaud et al., 2020). Postural improvement was also reported by participants who reduced sitting time (Chau et al., 2014; Gradidge et al., 2022). Relief from musculoskeletal discomfort was experienced as participants reported relief from pain symptoms in the neck, back, and shoulders (Biddle et al., 2020; Dutta et al., 2015; Edwardson et al., 2023; Gradidge et al., 2022; Hadgraft et al., 2017). Through the use of SSDs, participants noted a positive association between the intervention and their health status and well-being, reducing the number of sick days. Many reported feeling relaxed during the workday and several participants were optimistic about the idea that a healthier work environment could result in overall increased productivity (Brierley et al., 2022).

***Health risks.*** Some testimonies from participants revealed experiences that somehow conditioned their use of SSDs. Pain symptoms and discomfort were reported by some participants when using them during the intervention period. These reports were considered as "health risks", since they were generally related to musculoskeletal problems that could potentially compromise participants health and influence the experience of using SSDs. At the beginning of the interventions, participants believed that transitioning to the use of SSDs in the workplace would alleviate symptoms of pain and discomfort, especially in the lower back, resulting from the usual sitting posture (Henderson et al., 2018; Renaud et al., 2020). However, some participants experienced difficulties in adaptation, exhibiting a higher degree of fatigue and generalized musculoskeletal discomfort at the beginning of the intervention (Dutta et al., 2015; Wilkerson et al., 2019). Symptoms such as feet pain (Edwardson et al., 2023; Wilkerson et al., 2019), lower back pain (Brierley et al., 2022; Graves et al., 2015), neck pain (Edwardson et al., 2023), and shoulder pain (Hadgraft et al., 2017) were reported, particularly with prolonged use of the SSD during the day, which made the experience of working while standing impractical (Renaud et al., 2020). In addition to discomfort in these anatomical regions related to the use of the SSD, a feeling of tension in the back was also reported, related to the ergonomics of the SSD (different from the usual desk) (Chau et al., 2014), especially when manually raising it to the standing position (standing position)

(Engelen et al., 2019). For some participants, the idea began to emerge that, given the difficulty of using SSDs due to musculoskeletal discomfort, the intervention could somehow compromise their own health (Henderson et al., 2018). However, different opinions were noted, with other participants considering greater health risks when spending more time in the seated position than when using SSDs, and consequently spending more time standing (Gradidge et al., 2022). When asked about the reasons for returning to work seated, some participants mentioned fatigue and comfort, while others reported a significant improvement in musculoskeletal discomfort as the intervention progressed (Hadgraft et al., 2017).

***Supporting factors.*** Several factors proved to be important in the participants' varying degrees of utilization of SSDs. Some interventions showed a structure that included not only the implementation of SSDs in the workplace, but also the provision of advice aimed at maximizing the experience in some way. Strategies were developed by the participants themselves who, over the course of the intervention, adapted their personal context to create new routines and make the use of SSDs easier. In general, digital reminders were seen as a positive and useful strategy (Renaud et al., 2018), helping to combat forgetfulness in using the SSD (Wilkerson et al., 2019) and facilitating the establishment of a new routine that maximized standing time at work (Renaud et al., 2020). Self-monitoring and prompt tools increased participants' awareness of prolonged sitting time (Brierley et al., 2022), the importance of taking frequent breaks (Renaud et al., 2020), and demonstrated that they were not as active as they thought (Edwardson et al., 2023). It was also helpful to set personal goals for using the SSDs and to review progress throughout the intervention (Biddle et al., 2020). Some participants ended up investing in equipment that would enhance their standing experience, such as comfortable footwear and anti-fatigue mats (Dutta et al., 2015; Henderson et al., 2018; Wilkerson et al., 2019). Routine-related strategies were also developed by some participants, such as leaving the desk in the raised position when leaving work and keeping it in that position at fixed times of the day (Renaud et al., 2020)

***Knowledge***. During the interventions, several participants expressed their opinion about the information provided to them regarding the use of SSDs. Participants' awareness of the benefits and risks associated with the use of SSDs, as well as their correct utilization, were topics addressed during the interventions. Some participants revealed themselves to be well-informed regarding the ergonomic principles associated with the standing posture at work, as well as the risks associated with excessive sitting time (Henderson et al., 2018; Renaud et al.,

2020). Some, who already showed some knowledge in this area, ended up making their own adjustments to the SSD, although resorting to unapproved methods (Engelen et al., 2019).

The transition to using SSDs was not an automatic process for some, as they reported some initial difficulty in knowing how to correctly use the SSD (Chau et al., 2014). Several participants mentioned that they felt they needed more information, not so much on how to operate the SSD, but rather on how to adjust its height in order to minimize injuries or discomfort resulting from the standing posture. Although in some cases a personalized explanation, usage advice, and an informational leaflet were provided, it was not sufficient for some participants to be enlightened regarding the use of SSDs (Brierley et al., 2022). Some participants reported a lack of personalized training throughout the intervention, with some resorting to their own internet research to obtain more knowledge on how to correctly use the SSD (Henderson et al., 2018). The presence of a person responsible for the intervention at the location where the SSDs were placed was also noted as a necessity, in order to ensure that the space was ergonomically friendly and functional after the installation of the SSD (Henderson et al., 2018).

Various forms of information provision regarding the use of SSDs were reported, with personalized messages containing educational content being well received by some participants (Edwardson et al., 2023). Some gained greater knowledge during the intervention regarding the risks of spending more time seated, as well as the benefits associated with spending more time in a standing posture, suggesting interest in other workplace health promotion interventions (Renaud et al., 2018). Some participants mentioned after the intervention that greater knowledge about the option of working while standing, as well as its benefits, would lead more people in the future to opt for a SSD (Wilkerson et al., 2019).

***Motivations.*** This theme concerns the motivations of the participants inherent to their participation in an intervention involving the use of SSDs. It reflects the motivations reported prior to the intervention based on the information provided to them, their perspectives regarding the intervention itself, and also reflects the opinions resulting from participation in the intervention It was found that some participants showed high motivation after the intervention, transferring the idea of standing to other contexts in their lives outside of work, while others did not report this change due to the intervention (Hadgraft et al., 2017). In some cases, motivated by potential health benefits, some participants committed to using the SSD even before they were installed (Grunseit et al., 2013). Some non-users reported noticing

similar products being promoted and expressed interest in trying them out within their own personal work environment (Gradidge et al., 2022).

Since participation in SSD interventions was voluntary, some participants were intrinsically motivated (Edwardson et al., 2023), although extrinsic motivations were also suggested (Brierley et al., 2022). Before some interventions, several participants were intrinsically motivated, and these motivations were grouped into three main themes: Experimenting with something new; Interest in potential health benefits; and Relevance to the participant's own and organization's work (Chau et al., 2014).

***Work routine***. Distinct from the aforementioned theme of "Habit", work routine was associated with testimonies regarding the various types of tasks performed at work, which favored greater or lesser utilization of SSDs. It reflects not only the most opportune moments for longer periods in the standing position, but also the perception of productivity and attention observed during transitions between sitting and SPs, according to the type of task being performed. The testimonies from different participants reveal heterogeneity in how they perceived the experience of using SSDs, in relation to the tasks they had to perform at work. Some mentioned that transitioning from a seated to a standing position did not affect their concentration and alertness at work (Biddle et al., 2020; Graves et al., 2015). They even expressed feeling more attentive and productive at work, viewing the change in position as a shift in perspective and focus for work tasks (Renaud et al., 2020). Tasks such as answering calls, answering emails, and administrative work were seen as more suitable tasks when standing (Gradidge et al., 2022), while more substantial writing tasks were deemed more effectively performed while seated (Edwardson et al., 2023). These testimonies revealed the opinion that tasks requiring more concentration were more easily performed while seated. The importance of the task, as well as the existence of work deadlines, proved to be barriers to greater utilization of SSDs (Edwardson et al., 2023; Wilkerson et al., 2019). Other opinions suggested that people seemed more distracted while standing, which somehow reflected in their work productivity (Brierley et al., 2022; Henderson et al., 2018; Renaud et al., 2020).

Some participants mentioned finding it useful to use prompts at certain times of the day as a reminder to stand and executing specific work tasks while standing with the desk raised (Hadgraft et al., 2017). For some, a pattern was observed in the choice of times of day for working in a standing position, while for others, this process ended up being more random (Chau et al., 2014; Renaud et al., 2020).

*Interpersonal level*

***Social support.*** This theme reflects the external support felt by the participants, which ultimately influenced their experience of using SSDs. It also pertains to the influence that the SSD intervention had on other workers who, being outside observers, were somehow influenced by the workplace culture established. The importance of both colleagues and supervisors in the workplace was mentioned, as well as how the interventions unfolded, demonstrating a positive work culture. Many participants revealed that verbal social support from coworkers somehow encouraged the use of SSDs (Renaud et al., 2018; Wilkerson et al., 2019). In addition to verbally expressed support, simply looking to the side and seeing a colleague using one, influenced them to stand up as well (Dutta et al., 2015; Hadgraft et al., 2017; Wilkerson et al., 2019). In addition to the support shown by colleagues, the relevance of support expressed by managers and supervisors was mentioned, revealing the idea of a workplace culture of well-being (Wilkerson et al., 2019). This support served as an extrinsic motivation for some participants who were not yet using SSDs and felt tempted to try them out (Chau et al., 2014; Graves et al., 2015).

Group sessions or catch-up sessions with intervention participants were considered essential by many, as they provided an opportunity to discuss the idea of spending less time sitting, reflect on the intervention, share ideas, and discuss identified barriers (Brierley et al., 2022; Edwardson et al., 2023; Hadgraft et al., 2017). It also helped some to form plans, gain motivation, and devise new strategies to maximize the experience (Biddle et al., 2020). Many participants considered managers' involvement in the intervention to be important, as it could in some way convey a leading example for all employees (Renaud et al., 2020). Many viewed the interventions as desirable and sustainable (Henderson et al., 2018) and felt that a supportive work environment helped to normalize standing at work in an open planned space (Chau et al., 2014).

*Environmental level*

***Access.*** Access to SSDs was a theme addressed by several participants in the interventions. It primarily concerns testimonials, during and after the intervention, regarding the potential future acquisition of SSDs. The most determining factor in continuing the use of a SSD, mentioned by the majority of participants, was the cost of the SSDs (Wilkerson et al.,

2019). With the end of the intervention, in most studies, there was no longer access to SSDs unless the participant purchased one themselves. Due to affordability reasons, some participants were unable to maintain SSD (Gradidge et al., 2022). In other studies, access to SSDs varied by company department, as not all had the same access to their use (Wilkerson et al., 2019).

Certain interventions featured more than one study group, with some having access to SSDs and others only receive awareness training on the importance of reducing sedentary time. Participants in the last group noted some difficulty in reducing sitting time, as only the other study group had access to SSDs (Edwardson et al., 2023).

In certain situations, and with some effort, it was possible to maintain the SSDs. However, these were only available to those who could justify their use with health reasons (Hadgraft et al., 2017). Overall, the majority of participants would like to continue using SSDs if provided by management (Brierley et al., 2022; Gradidge et al., 2022; Graves et al., 2015). In cases where it was not possible to maintain the SSD after the intervention, a greater difficulty in reducing sitting time was reported (Hadgraft et al., 2017).

***SSDs characteristics.*** This theme essentially refers to feedback concerning the structural and functional characteristics of SSDs, as well as participants' accommodation regarding their use. It encompasses aspects of logistics and functionality, as it reflects the ease or difficulty in performing work-related tasks using the SSD while in a standing position. Many participants referred that the functionality of many tabletop computer SSDs was limited by the existing office infrastructure, such as shelves, credenzas, and cabinets. Participants also mentioned that the presence of office furniture made it difficult to accommodate the SSD (Wilkerson et al., 2019).

The issue of lack of space was the most mentioned by participants (Biddle et al., 2020; Brierley et al., 2022; Dutta et al., 2015; Edwardson et al., 2023; Graves et al., 2015; Henderson et al., 2018; Wilkerson et al., 2019). The support platform for the computer and office materials was found to be quite limited and unstable (Hadgraft et al., 2017), making it difficult to perform some tasks and consequently leading to frequent document spills (Biddle et al., 2020). The design of the SSD model was also questioned by several participants (Chau et al., 2014; Hadgraft et al., 2017), as it was not adapted for the participants' personal computers, causing problems when raising the desk (Biddle et al., 2020; Gradidge et al., 2022). Some participants showed difficulty in operating the SSD (Edwardson et al., 2023), which would require more time to organize the work environment (Biddle et al., 2020).

Overall, participants encountered difficulties related to ergonomic and anthropometric issues that somehow compromised their use of SSDs. Several suggestions were provided by participants to improve interventions. These included the possibility of having more space on the SSD platform, the need for more stability on the platform when it is in the standing position, and a more suitable adjustment for taller individuals (Chau et al., 2014).

***Workplace norms/culture.*** The workplace is an environment subject to interaction between various factors, be they human or material. Within each workplace, rules, dynamics, and objectives define a norm or work culture. In this case, this theme refers to the testimonies of participants regarding the limitations and incentives related to the norms and culture present in the workplace when using SSDs. Many participants found office norms to be one of the most influential barriers to standing at work and discussed how breaking this traditional approach to work was challenging to overcome. Several participants discussed how they would not stand in a meeting or in their office with someone else, in fear they would be perceived as overexerting power or dominance over the other person (Wilkerson et al., 2019). This idea stems from the general belief that both the workplace and society at large are structured around the idea of sitting (Chau et al., 2014; Edwardson et al., 2023). Some felt participants self-conscious about being the only ones using a SSD (Edwardson et al., 2023). They also felt that standing distracted their colleagues (Brierley et al., 2022; Graves et al., 2015), invading their privacy, and sometimes unintentionally sharing confidential communications when on the phone (Chau et al., 2014). They also mentioned the perception of increased noise in the workspace due to standing, which often disrupted the workflow (Hadgraft et al., 2017). However, other participants revealed feeling comfortable working in a standing position in front of their colleagues (Graves et al., 2015). They mentioned that standing often facilitated communication with other workers because they were more visible (Hadgraft et al., 2017). Additionally, some mentioned a dynamic where when one person stands up, others feel more motivated to do the same(Biddle et al., 2020).

For participants who considered the experience positive, they noted difficulty in requesting the continuation of SSDs as supervisors might consider them expensive and unnecessary (Wilkerson et al., 2019). They observed that they needed an incentive, such as increased productivity, for the supervisor to consider acquiring SSDs (Brierley et al., 2022). Overall, participants considered receiving support from their supervisor regarding standing during the workday extremely influential on their behavior and on encouraging them to use their SSD (Hadgraft et al., 2017). Thus, the most common environmental-level facilitator was

a supportive workplace culture, which includes receiving manager or supervisor support for standing and the presence of an overall culture of wellness within the workplace (Wilkerson et al., 2019).

*Barriers and facilitators*

According to the testimonies presented by the participants in the 14 studies included in this review, regarding interventions using SSDs and grouped according to the Socio-Ecological Model, an analysis was conducted of the themes that acted as barriers or facilitators to the use of SSDs. Within the term 'Intrapersonal', 8 themes were identified: Acceptability; Habit; Health benefits; Health risks; Knowledge; Motivations; Supporting factors; and Work routine. Under the term 'Interpersonal', the theme Social support was identified. In the term 'Environmental', three themes were found: Access; SSDs characteristics; and Workplace norms/culture. When analyzing the testimonies of the participants in the 14 studies each theme was considered as a barrier, facilitator, or both, depending on the context. On Table 5 the distribution of the various themes according to the Socio-Ecological Model is showed, classifying each theme as a barrier or facilitator for each one of the 14 studies included in this systematic review.

## II.4 Discussion

This systematic review aimed to examine the latest qualitative data regarding studies containing participants' perceptions and perspectives on interventions using SSDs, as well as to identify the main barriers and facilitators to their use in the workplace. Thus, aiming to address existing limitations in literature regarding detailed qualitative data evaluating users' experiences and perspectives related to SSDs, as pointed out by Nooijen et al. (2018).

From the 14 eligible studies for this systematic review, a Thematic Analysis was performed to analyze the participants' testimonies from these studies, regarding their experience of using SSDs. Initially, a line-by-line coding of the qualitative data present in the results of each of the verified studies was conducted, corresponding to the first two steps of the Data Synthesis model proposed by Thomas and Harden. (2008). Instead of defining analytical terms according to the Data Synthesis model, the Socio-Ecological Model (Owen et al., 2011)

**Table 5 - Themes organized according to Socio-Ecological Model synthesizing the barriers and facilitators to the use of SSDs**

| Socio-Ecological Model | Themes | Study Number | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| **Intrapersonal** | Acceptability | | ○ | ◑ | ○ | ○ | | ○ | ○ | | | | | | |
| | Habit | ● | | ○ | ◑ | ◑ | | | ○ | ● | ● | ● | ◑ | ● | |
| | Health benefits | | ○ | ○ | ○ | | ○ | ○ | | ○ | ○ | ○ | ○ | ○ | ○ |
| | Health risks | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | |
| | Knowledge | ◑ | ◑ | ○ | ◑ | | | | ○ | ○ | ○ | ○ | | ◑ | ● |
| | Motivations | | | ○ | ○ | | | ○ | | | ○ | ◑ | | | ○ |
| | Supporting factors | ○ | ○ | ○ | ○ | | ○ | | ○ | ○ | ○ | | ○ | ○ | |
| | Work routine | ● | ◑ | ○ | ◑ | ◑ | | ◑ | | ○ | ◑ | ◑ | ○ | ◑ | ● |
| **Interpersonal** | Social support | ○ | ○ | ○ | ○ | ○ | ○ | | | ○ | ○ | ○ | ○ | ○ | |
| **Environmental** | Access | ● | | | ● | ● | | ● | | | ● | ● | | | |
| | SSDs characteristics | ● | ● | ◑ | ● | ● | ● | ● | ● | | ● | ◑ | ● | ● | ● |
| | Workplace norms/culture | ◑ | | ◑ | ● | ◑ | | | | ○ | ● | ◑ | ○ | ● | |

Facilitator ○; Barrier ●; Facilitator and Barrier ◑; Study number according to first author and year of publication: 1. Wilkerson (2019); 2. Henderson (2018); 3. Chau (2014); 4. Brierly (2022); 5. Graves (2015); 6. Dutta (2015); 7. Gradidge (2022); 8. Engelen (2018); 9. Renaud (2018); 10. Edwardson (2023); 11. Hadgraft (2017); 12. Biddle (2020); 13. Renaud (2020); 14. Grunseit (2013)

Note: Table based on Martins et al. (2021)

was adopted with the aim of categorizing the identified themes into intrapersonal, interpersonal, and environmental levels, as observed in a study by Wilkerson et al. (2021). In a final analysis, the identified themes were reorganized according to the Socio-Ecological Model into barriers and facilitators to the use of SSDs, with the aim of understanding to some extent the success and applicability of the interventions performed, as well as suggesting improvements in conducting future studies in the field.

Regarding the acceptance of interventions with SSDs, a generally positive response from participants was observed, although some pointed out barriers to their use. Several mentioned SSDs were easy to use and an effective way to help break SB, consistent with previous findings of Neuhaus et al. (2014) and Torbeyns et al. (2014). However, other opinions revealed a sense of loss of functionality of the workspace and difficulties with the SSD model as reasons for reduced usage, mirroring prior results of Hadgraft et al. (2018). Nevertheless, several testimonies expressed the intention to continue using SSDs in the future.

One of the main barriers reported was the issue of habit, given that testimonies pointed to the idea that it is difficult to change a long-established habit, such as working in a seated position. Although participating in an intervention involving the acquisition of SSDs, the fact that participants were not accustomed to their use often led to forgetting to raise the desk. Other participants saw the interventions as an opportunity to change older habits by creating new routines. The access to SSDs was motivation enough for them to stand while at work. In some cases, changes in new habits outside the workplace were reported due to the intervention, such as spending more time standing at home and when using public transportation.

In a systematic review by Tew et al. (2015), the existence of methodologically limited evidence regarding studies on the use of SSDs was pointed out, suggesting the development of more precise future approaches in the area, particularly regarding health benefits and productivity at work. In this review, participant testimonies that pointed to health-related benefits associated with the use of SSDs were found, consistent with the findings of Leavy et al. (2016). Some participants noted, during the intervention, a decrease in fatigue and boredom levels, feeling more energetic during work time. Changes in a more cognitive aspect were reported by some participants, such as increased focus, alertness, productivity, concentration, and confidence at work. Improvements in physical aspects were also noted, reporting better posture, reduced discomfort in the neck, shoulders, and back region. Several

participants noticed a relationship between their health, well-being, reduction in sick days, and the idea of being healthier could result in increased productivity. These results were also Other participants reported feeling supported throughout the intervention, as they received personalized educational messages regarding both usage and the benefits of correctly using SSDs. The importance of providing information about the option to work standing up, as well as its benefits, was seen as essential by many and, in a way, fosters the idea of a greater number of people using SSDs in the future.

Motivation also proved to be an important factor during the interventions. In some cases, participants had access to information regarding the potential health benefits, which motivated them to commit to using SSDs even before the intervention began. In studies with groups using SSDs and groups that did not, some participants showed curiosity about trying it in their own work environment. Given that participation in the studies was voluntary, it can be observed that the participants were intrinsically motivated. In a study by Chau et al. (2014)(Chau et al., 2014), it was even possible to identify the motivations present in the participants: trying something new; interest in potential health benefits; and relevance to the participant's own and organization's work.

The transition from working in a seated position to standing was demanding due to another circumstance mentioned by the participants. Besides being a habit change, working in a standing position involves functional and practical adaptation when performing work tasks. Some participants mentioned that transitioning to a standing position did not affect their concentration and productivity, allowing them to work uninterrupted, which aligns with previous evidence of Hadgraft et al. (2018) and Ojo et al. (2018). However, many participants pointed out that not all tasks were easy to perform while standing. Tasks such as responding to emails, answering phone calls, and administrative work were deemed feasible while standing, whereas tasks requiring more concentration and work with deadlines were more easily done while seated.

Applying these interventions at workplaces led to frequent sharing of experiences and ideas. A common theme was the value of social support, as verbal encouragement from colleagues boosted the use of SSDs, and observing others using these desks also promoted their use. Group sessions allowed participants to reflect, share ideas, and devise strategies for standing more, while also managerial support further normalized standing while working.

A major difficulty reported was the access to SSDs, especially post-intervention. Cost was a significant barrier, as many participants could not afford them, but wanted to continue

its use if provided by employers. Some could keep the desks only with medical proof of necessity, leading to difficulties in reducing sitting time at work. Other negatives aspects of using SSDs included impractical functionality due to office infrastructure, limited space on the computer platform, and design issues. These factors hindered usability and adaptability, particularly for taller individuals.

Some testimonies revealed the opinion that society, and consequently the workplace, is shaped around the idea of sitting. It was mentioned that some individuals felt self-conscious when they were the only ones using a SSD, as they felt they were distracting their colleagues, invading their privacy, and inadvertently sharing confidential information when on the phone. On the other hand, other participants felt comfortable standing in front of their colleagues, as it facilitated communication by making them more visible. For those whose experience was positive, they noted difficulty in requesting the continuation of SSDs due to the notion that supervisors might consider it costly and unnecessary. In line with another systematic review of Michalchuck et al. (2022), participants felt that a supportive workplace culture, facilitated by managerial supervision, acted as a facilitator for standing and promoting a culture of well-being in the workplace.

Regarding barriers and facilitators, the themes "Health risks", "SSDs characteristics" and "Access" were seen by most studies as barriers, while "Health benefits," "Supporting factors," and "Social support" were seen as facilitators of SSD use. The themes "Habit," "Knowledge," "Work Routine," and "Workplace norms/culture" were seen as both barriers and facilitators, depending on the context.

This systematic review aimed to understand the factors that enable the effective implementation of workplace sitting interventions. To this end, it was designed using the identification and application of a theoretical model (Socio-Ecological Model), and finally, the identification of barriers and facilitators to the use of SSDs. This approach by Mackenzie et al. (2018) aims to develop an informative operational model for planning "sit less" interventions. By utilizing the most recent qualitative information regarding interventions involving SSDs, it was possible to gain insight into the perspectives/perceptions of the participants regarding the interventions. The themes most frequently addressed by the participants were identified, as well as those that emerged as barriers or facilitators to the use of SSDs. These findings may provide new insights for future interventions involving SSDs, so that they may achieve greater adherence, fewer barriers to their use, and consequently, a better outcome.

## II.5 Strengths and Limitations

This systematic review has strengths in that it was conducted according to recent qualitative evidence, with robust theory-based evidence for data analyses. Regarding the eligibility criteria for studies, it was based on the Sample, Phenomenon of Interest, Design, Evaluation, and Research type (SPIDER) tool. For the Data Analysis and Data Synthesis process, the thematic analysis approach was used, comprising the first two steps of the Data Synthesis process proposed by Thomas & Harden. (2018) in the first phase, the Socio-Ecological Model proposed by Owen et al. (2017) in the second phase, and the characterization of barriers and facilitators to the use of SSDs proposed by Mackenzie et al. (2018) in the third phase. A strength identified was that the 14 eligible studies were from five countries across four continents, providing a global understanding of knowledge on SSDs interventions.

One limitation found was that the search was conducted only in three databases (PubMed, B-On, and SportDiscus), which may have limited the number of studies included in this review. Another limitation was the scarcity of evidence regarding systematic reviews on qualitative approaches to interventions involving SSDs. Thus, there was a lack of robust comparison terms for this systematic review, compromising the discussion and analysis of other similar approaches. This limitation suggests that this systematic review could serve as a basis for the development of future systematic reviews in the area, encompassing a more robust number of eligible studies and consequently providing new ideas for more effective future research involving SSDs interventions.

## II.6 Conclusions

This systematic review summarizes the perceptions/perspectives of participants in interventions involving SSDs. Several participants noted health-related benefits and felt that support from colleagues and supervisors facilitated the creation of a culture of well-being and normalization of standing at the workplace. However, the information provided to participants on how to use the SSDs effectively and its benefits was not well-received or assimilated by many, leading to difficulties in utilizing the SSDs. Symptoms such as musculoskeletal pain and discomfort were reported, as well as difficulties in acquiring a SSD after the intervention due to cost. For some, the habit of working in a seated position was identified as a barrier,

while others, simply by having access to SSDs, saw an opportunity to create new routines and habits of working while standing. Participants also mentioned the type of tasks to be performed at work as a limitation, as some tasks requiring more concentration and deadlines were more difficult to execute in a standing position. Design was also identified as a difficulty in the use of SSDs, with the lack of space on the computer platform reported as the main obstacle to performing work smoothly, leading to the need to spend time organizing work logistics.

The use SSDs appears to be an effective way to reduce time spent sitting at the workplace, with interventions generally being accepted by participants. Future research should develop interventions that consider the key identified barriers and facilitators to improve the experience of using SSDs.

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# CHAPTER III

## Barriers and Facilitators to the use of SSD: Perceptions from participants in the SUFHA Intervention

## Resumo

**Introdução:** As secretárias ajustáveis para trabalho sentado/de pé (SSD) têm sido implementadas em vários ambientes de trabalho com o objetivo de reduzir o comportamento sedentário (CS). As evidências demonstraram a eficácia das SSD na redução do CS e na melhoria da saúde e produtividade dos trabalhadores. No entanto, há pouca literatura sobre as perceções dos participantes quanto ao uso das SSD durante as intervenções. Alguns estudos relatam que os participantes sentiram alívio postural e redução do desconforto músculo-esquelético, embora outros tenham reportado dores lombares, fadiga nas pernas e desconforto nos pés durante o uso das SSD. O custo e o design das SSD foram citados como barreiras, com o último a causar interrupções no fluxo de trabalho e desconforto nas articulações dos braços. O apoio social de colegas, o desenvolvimento de novos hábitos e a consciencialização dos benefícios de reduzir o CS parecem facilitar o uso das SSD. Embora já tenham sido realizados estudos nesta área, não existe literatura deste género em Portugal. Portanto, o objetivo deste estudo é avaliar as perceções dos participantes na intervenção SUFHA (Stand Up for Healthy Aging) em relação à sua experiência com as SSD e comparar os resultados com as evidências recentes.

**Métodos:** Este estudo é uma análise qualitativa da intervenção SUFHA, utilizando uma amostra de 19 participantes (o grupo de intervenção do estudo SUFHA que utilizou SSD), cujas perceções sobre o uso das SSD foram recolhidas através de questionários mensais de satisfação e entrevistas semiestruturadas. Foi realizada uma análise qualitativa das variáveis dos questionários, juntamente com uma análise temática das entrevistas semiestruturadas, com o objetivo de identificar as principais barreiras e facilitadores ao uso das SSD.

**Resultados:** As SSD foram, em geral, bem aceites pelos participantes como uma forma eficaz de reduzir o CS. Os participantes relataram que as secretárias eram fáceis de usar, úteis para criar novos hábitos que interrompessem o CS, e algo que gostariam de continuar a utilizar no futuro. O conhecimento prévio dos benefícios de reduzir o CS foi importante para alguns, aumentando a consciencialização sobre o uso das SSD. Notaram-se melhorias na postura e alívio do desconforto músculo-esquelético, embora alguns participantes tenham experimentado desconforto, como dores lombares, nas pernas e nos pés. Segundo alguns participantes, o uso das SSD variava consoante a carga de trabalho e o tipo de tarefa. Muitos relataram limitações no design das SSD, especificamente no espaço da plataforma e no

mecanismo de ajuste da altura da secretária, levando a desconforto nos ombros, cotovelos e pulsos.

**Conclusões:** As SSD foram geralmente bem aceites pelos participantes, sendo fáceis de adaptar, oferecendo alguns benefícios de saúde associados e vistas como algo que gostariam de manter a longo prazo. Abordagens futuras devem considerar o design das SSD, particularmente o espaço da plataforma e o ajuste, garantindo que a secretária seja prática, funcional e não prejudique a saúde dos trabalhadores. Investigações futuras devem adotar uma perspetiva intrapessoal, interpessoal e ambiental para obter informações qualitativas mais detalhadas, melhorando assim a compreensão das barreiras e facilitadores ao uso das SSD.

**Palavras-chave:** Secretárias ajustáveis em altura, comportamento sedentário, intervenção, local de trabalho, experiência dos participantes, barreiras, facilitadores.

## Abstract

**Background:** Sit-stand desks (SSDs) have been implemented in various work environments with the aim of reducing sedentary behavior (SB). Evidence has demonstrated the effectiveness of SSDs in reducing SB and improving workers' health and productivity. However, there is limited literature on participants' perceptions of SSDs use during interventions. Some studies report that participants experienced postural relief and reduced musculoskeletal discomfort, though some reported lower back pain, leg fatigue, and foot discomfort during SSDs use. Cost and SSDs design have been cited as barriers, with the latter causing disruptions to workflow and arm joints discomfort. Social support from colleagues, the development of new habits, and awareness of the benefits of reducing SB appear to facilitate SSD use. Although studies have been conducted in this field, there is no existing literature of this kind in Portugal. Therefore, the aim of this study is to assess the perceptions of participants in the SUFHA (Stand Up for Healthy Aging) intervention regarding their experience with SSDs and to compare the findings with recent evidence.

**Methods:** This study is a qualitative analysis of the SUFHA intervention, using a sample of 19 participants (the SUFHA study's intervention group that used SSDs) from whom SSD usage perceptions were collected through monthly satisfaction questionnaires and semi-structured interviews. A qualitative analysis of the questionnaire variables was conducted, along with a thematic analysis of the semi-structured interviews, with the aim of identifying the main barriers and facilitators to SSD usage.

**Results:** SSDs were generally well accepted by participants as an effective way to reduce SB. Participants reported them as easy to use, helpful in creating new habits for interrupting SB, and something they would like to continue using in the future. Prior knowledge of the benefits of reducing SB was important for some in increasing SSD usage awareness. Improvements in posture and relief from musculoskeletal discomfort were noted, though some experienced discomfort such as lower back, leg, and foot pain. According to some participants, SSD usage varied depending on workload and task type. Many reported limitations in SSDs design, specifically with platform space and the desk's height adjustment mechanism, leading to discomfort in the shoulders, elbows, and wrists.

**Conclusions**: SSDs were generally well accepted by participants, being easy to adapt to, offering some associated health benefits, and seen as something they would like to maintain in the long term. Future approaches should consider the design of SSDs, particularly the

platform space and adjustment, ensuring the desk is practical to use, functional, and does not harm workers' health. Future research should adopt an intrapersonal, interpersonal, and environmental perspective to gain more detailed qualitative insights, ultimately improving the understanding of barriers and facilitators to the use of SSDs.

**Keywords:** Sit-stand desk, sedentary behavior, workplace, intervention, participants' experience, barriers, facilitators.

## III.1 Introduction

Sit-stand desks (SSDs) have been implemented in various office environments with the aim of reducing sedentary behavior (SB) during working hours, promoting regular changes in posture, and thereby helping to alleviate the adverse effects of prolonged SB on overall health (Hadgraft et al., 2021). Evidence has demonstrated that breaking up periods of prolonged sitting may have beneficial effects on markers of cardiometabolic risk and body composition (Saunders et al., 2020). It was also verified the effectiveness of SSDs in reducing SB and improving the health and productivity of workers (Wilkerson et al., 2019). However, there is little existing literature regarding detailed qualitative data evaluating users' perceptions related to SSDs (Nooijen et al., 2018).

According to the Cambridge Dictionary, perceptions are the beliefs and opinions held by several people based on how things appear. In this case, perceptions refer to the opinion of participants in interventions using SSDs regarding their experience of use.

Some studies have gathered information from participants in SSDs interventions to understand key themes related to their experiences. Overall, participants show acceptance for the experience of using SSDs, describing it as a positive intervention in the workplace (Engelen et al., 2019), easy to use (Graves et al., 2015), and something they would like to maintain for the future (Brierley et al., 2022). Many participants reported health benefits, such as reduced fatigue and increased energy (Biddle et al., 2020; Brierley et al., 2022; Dutta et al., 2015), along with improvements in focus, alertness, and productivity (Chau et al., 2014; Edwardson et al., 2023). Postural improvements were also noted, leading to reduced musculoskeletal discomfort, particularly in the neck, back, and shoulders (Gradidge et al., 2022). However, some participants faced difficulties at the start of interventions, including

feeling increased fatigue and pain, notably in the feet and lower back, as a result of prolonged SSD use (Wilkerson et al., 2019).

In some studies, breaking the habit of sitting remained a challenge for many participants, even with the introduction of new equipment, and participants often forgot to use the SSDs (Renaud et al., 2020; Wilkerson et al., 2019). Some authors concluded that digital reminders and self-monitoring tools helped participants increase their awareness of prolonged sitting and establish routines for using SSDs (Brierley et al., 2022; Renaud et al., 2020).

SSDs usage also varied depending on the type of task. Standing was preferred for administrative tasks, like answering calls or responding to emails, while seated work was seen as more efficient for tasks requiring higher concentration, such as significant writing (Edwardson et al., 2023; Gradidge et al., 2022). Task demands and deadlines were noted as key obstacles to increasing SSD use (Edwardson et al., 2023).

Evidence has pointed design limitations of SSDs, such as insufficient space for office materials and unstable platforms, as major challenges to effective use (Biddle et al., 2020; Henderson et al., 2018). In some cases, participants invested in ergonomic equipment, such as anti-fatigue mats and comfortable footwear, to improve their standing experience (Dutta et al., 2015). Although many participants were knowledgeable about ergonomic principles, some expressed a need for more personalized guidance, particularly on adjusting desk height to prevent discomfort (Graves et al., 2015; Grunseit et al., 2013).

Cost was another major barrier to continued SSD use post-intervention, with many participants unable to afford their own SSDs after the study ended (Gradidge et al., 2022). Furthermore, participants were often hesitant to use SSDs in meetings or group settings due to concerns about appearing dominant or distracting colleagues (Wilkerson et al., 2019). Despite these challenges, participants with positive experiences expressed a desire to continue using SSDs, particularly if supported by their supervisors and organizations (Brierley et al., 2022; Graves et al., 2015). Social support from co-workers and supervisors was actually identified as a crucial factor in encouraging the use of SSDs, fostering a culture of well-being and motivation in the workplace (Wilkerson et al., 2019). Group sessions also helped participants share ideas, reflect on the intervention, and address barriers to reducing sitting time (sitting time) (Brierley et al., 2022; Hadgraft et al., 2017).

Most of the qualitative evidence on interventions using SSDs in adults over a period of six months is produced with participants from English-speaking countries (e.g., USA, UK, Australia). As such, there is a need for understanding if the participants' experiences and

perceptions in these contexts is comparable to qualitative data obtained from other cultural backgrounds, such as the Portuguese context.

The main goal of the present study is to analyse qualitative data regarding perceptions from the use of SSDs by participants in the Stand up for Healthy Aging (SUFHA) intervention. It also aims to define the main barriers and facilitators for the use of SSDs, and compare the data obtained in the SUFHA intervention with results from other interventions.

## III.2 Methods

### *Study design and setting*

This study performs a Qualitative Analysis of data collected as part of a randomized controlled cluster trial with two parallel arms (1:1), superiority design, with thirty eight (38) participants, with measurements taken at baseline and at the end of six months (SUFHA) (Júdice et al., 2023). The SUFHA study mainly aimed to evaluate changes in sedentary patterns (quantity and accumulation pattern) following the introduction of SSDs in the workplace for the intervention group (nineteen (19) participants), compared to a control group (nineteen (19) participants), over a six-month intervention period. Secondary outcomes included body composition, dietary habits, health and work-related outcomes, skeletal muscle discomfort, well-being, quality of life, as well as the acceptance levels of SSDs in both groups throughout the entire intervention period. More detailed information in intervention description can be found elsewhere (Júdice et al., 2023).

Since this study aims to evaluate the perceptions of SSDs usage by participants in the SUFHA intervention, only qualitative data from the intervention group was analyzed.

### *Sampling and recruitment*

The sample for this study reflects the sample used for the SUFHA study, consisting of individuals of both sexes, aged 20 years or older, working at least half time, spending at least 70% of a workweek on desk-related activities, and willing to install SSDs in their workplace (Júdice et al., 2023). Office-based workers were recruited through university advertisements. Interested individuals meeting the inclusion criteria were invited to participate in the trial with

SSDs. A website was created to provide participants with details about the RCT, assessments, expectations, and strategies for using the SSDs during the intervention (Júdice et al., 2023).

### *Ethics approval*

The SUFHA study was approved by the ethics commission of the Faculty of Physical Education and Sport at the University Lusófona in Lisbon (Approval number D0522). All participants provided written informed consent prior to their participation.

### *Data collection*

To collect testimonies regarding the perception of SSDs usage by SUFHA intervention participants, data was gathered through monthly satisfaction questionnaires and semi-structured interviews.

The monthly satisfaction questionnaire, validated by expert and face validity, was used to gather the experiences of participants from the intervention group regarding the use of SSDs. It consisted of a 10-question survey, formulated by the SUFHA research team, containing both open-ended and scale-format questions administered using the Qualtrics XM software. The questionnaire was sent to each participant in the intervention group by the same researcher at the end of each month, from February to July 2023, via email, through a link that participants accessed using a code to complete the survey. Responses to the monthly satisfaction questionnaire were collected to analyze qualitative data and identify barriers and facilitators to the use of SSDs, as well as their evolution over time. For this particular study, three out of the ten questions were analysed, as they pertained to qualitative data, with the variables "Strategies", "Difficulties", and "Discomfort". These were being evaluated through the questions, respectively: "Did you adopt any other strategy to reduce your sitting time at work and/or outside of work?"; "Did you experience any difficulties in using your desk?" and "Did you feel any discomfort while using the standing desk that made you sit back down?"

The semi-structured interviews were conducted with a convenience sub-sample of eight participants from the intervention group, who volunteered to provide their testimonies. These interviews consisted of four open-ended questions regarding their experience with SSDs usage and were collected via video by two SUFHA researchers. Initially, potential

questions were drafted, which were subsequently reviewed and validated by the principal investigator (PBJ). The validated interview questions were: "How has your experience with using a SSD been?"; "Do you think you would continue using a SSD after the study ends?"; "Do you find the SSDs implementation positive or negative?", and "Do you think you could apply the strategy of transitioning from sitting to standing in other contexts of your life?".

### *Data Analysis*

Regarding data analysis, two separate approaches were undertaken. This decision was due to the collection of qualitative information from two different avenues: data from the monthly satisfaction questionnaire of all nineteen (19) participants, and data from the semi-structured interviews from the convenience sub-sample of the intervention group with eight (8) participants.

To conduct a descriptive analysis of the intervention group and the convenience sub-sample, data were collected from the SUFHA study database and subsequently analyzed using IBM SPSS Statistics 29.0.1.0 software.

Semi-structured interviews conducted via video were transcribed using the TurboScribe program, resulting in a document containing the verbatim responses of the eight participants from the convenience sample. Next, the information related to the participants' testimonies was entered into the NVivo software (NVivo Windows® (Release 1.7.2)) in order to perform a Thematic Analysis, as done by previous studies (Chau et al., 2014; Engelen et al., 2019; Gradidge et al., 2022; Hadgraft et al., 2017; Henderson et al., 2018; Renaud et al., 2020; Wilkerson et al., 2019), with the goal of identifying emerging themes and understanding the testimonies about participants' perceptions regarding the use SSDs.

The initial analysis followed Thematic Synthesis, a three-step approach outlined by Thomas and Harden (Thomas & Harden, 2008), which facilitates a transparent summary of existing qualitative evidence and supports the development of new interpretive constructs, explanations, and hypotheses (Compernolle et al., 2020). This process refers to a line-by line coding and the definition of the main themes presented in the testimonies, and it was conducted independently by two researchers (MPP and SF), with differences resolved through discussion with a third researcher (PBJ). In a subsequent phase, rather than applying the third step of Thematic Synthesis, the Socio-Ecological Model of SB(Owen et al., 2011) was employed, as performed by Wilkerson et al. (2019). This model groups the results on three

levels: the intrapersonal level (individual beliefs, attitudes, behaviors), the interpersonal level (social factors), and the environmental level (workplace culture, environment); which were then utilized to categorize the identified themes and to group the barriers and facilitators associated with the use of SSDs.

## III.3 Results

The participants involved in the SUFHA study were identified by the lead investigators using an abbreviation of the term SUFHA followed by a participant number (ex., suf14). Accordingly, throughout the results section, this identifier will be used when presenting participant testimonies. The intervention group, from which qualitative data was gathered for this study, comprises 19 participants (suf04, suf05, suf06, suf07, suf10, suf11, suf12, suf13, suf14, suf17, suf19, suf22, suf25, suf27, suf30, suf31, suf32, suf33, and suf38), while the convenience sub-sample consists of 8 of these participants (suf04, suf06, suf07, suf10, suf11, suf12, suf25, and suf31).

As presented in Table 1, the 19 participants in the intervention group were predominantly women (78.9%), aged between 42 and 50 years (52.7%), and worked in Academic/Administrative Services (52.6%). The daily working time was mostly seven or eight hours (84.2%), and the primary mode of transportation to work was by car or motorcycle (84.2%). Approximately 78.9% did not have chronic illnesses, and about half (57.9%) engaged in regular physical activity.

### ***Monthly satisfaction questionnaire***

#### *Strategies*

The data related to the variable "Strategies" from the monthly satisfaction questionnaire reflects the response to the question: "Did you adopt any other strategy to reduce your sitting time both at work and/or outside of work?". The codes for each response were: 1 = "No, at work"; 2 = "Yes, at work"; 3 = "No, outside work" and 4 = "Yes, outside work". If the response was 2 or 4, the participant would describe the adopted strategy. Of the

19 participants, only 4 did not adopt strategies to reduce their sitting time both at work or outside work.

**Table 1 - Descriptive characteristics of the participants in the intervention group and the convenience sub-sample**

| | Intervention Group | | Convenience subsample | |
|---|---|---|---|---|
| | N=19 | % | N=8 | % |
| **Gender** | | | | |
| Female | 15 | 78.9 | 7 | 87.5 |
| Male | 4 | 21.1 | 1 | 12.5 |
| **Age** | | | | |
| 34-42 | 4 | 21.1 | 1 | 12.5 |
| 42-50 | 10 | 52.7 | 5 | 62.5 |
| 50-58 | 5 | 26.4 | 2 | 25.0 |
| **Profession/Function** | | | | |
| Academic/Administrative Services | 10 | 52.6 | 5 | 62.5 |
| Management/Administration Services | 4 | 21.1 | 2 | 25.0 |
| Others | 5 | 26.3 | 1 | 12.5 |
| **Daily working hours** | | | | |
| 7h | 8 | 42.1 | 5 | 62.5 |
| 8h | 8 | 42.1 | 2 | 25.0 |
| 9h | 1 | 5.3 | 1 | 12.5 |
| 11h | 1 | 5.3 | 0 | 0 |
| 12h | 1 | 5.3 | 0 | 0 |
| **Mode of transportation** | | | | |
| Car or motorcycle | 16 | 84.2 | 7 | 87.5 |
| Public transport | 3 | 15.8 | 1 | 12.5 |
| **Chronic disease** | | | | |
| Yes | 4 | 21.1 | 2 | 75.0 |
| No | 15 | 78.9 | 6 | 25.0 |
| **Physical activity** | | | | |
| Yes | 11 | 57.9 | 6 | 75.0 |
| No | 8 | 42.1 | 2 | 25.0 |

***Strategies to reduce sitting time at work.*** Some participants revealed the adoption of strategies to reduce sitting time in the workspace. One started to take more breaks during work (suf22), other opted to stand up every hour (suf30), other alternating 20 minutes standing and 20 minutes sitting (suf12) while others simply stood up more frequently and

walked around the office (suf27, suf13). It was found that one participant chose walking to reduce sitting time, other opted to take short walks within the workspace during working hours and lunch breaks (suf21), while other sought to stand up and walk while taking calls or to address matters with colleagues (suf33). Increasing the time spent standing was seen by some participants as a strategy, with one selecting easier work tasks to perform while standing (suf14), such as answering emails (suf04) and conducting meetings while standing (suf05, suf19). Other strategies to reduce sitting time included the use of software that reported the time spent standing or sitting (suf31) and more frequent use of stairs for moving within the workspace (suf10).

***Strategies to reduce sitting time outside the workplace.*** Some participants reported strategies they used to reduce sitting time outside the workplace during the intervention. These strategies included increasing physical activity (PA) and exercise levels. Walking was mentioned by the majority as a strategy (suf05, suf13, suf19, suf23, suf27). Additionally, some participants adopted more specific practices such as yoga (suf07, suf25), going to the gym (suf06, suf10), and cycling (suf33). Besides increasing exercise and PA levels, some participants mentioned making an effort to spend more time standing at home and during leisure activities (suf04, suf14), as well as spending less time sitting while watching television at home (suf27).

*Difficulties*

The data regarding the variable "Difficulties" reflects the responses to the question: "Did you experience any difficulty in using your sit-stand desk?". The codes for each response were: 0 = "No"; 1 = "Yes, which ones?". For participants who answered 1, a description of the difficulty(ies) experienced in using the SSD was reported. Of the 19 participants in the intervention group, 7 reported encountering some difficulties related to the use of the SSD at least once during the six months of intervention.

The SSD design was mentioned by several participants as a limitation to its use. The lack of space on the platform supporting the computer compromised tasks such as writing, accessing document folders, and files (suf04, suf17, suf27, suf38). Another issue related to the design of the SSD was the weight of the computer, which made it difficult to raise the desk when users wanted to work in a standing position (standing position) (suf07, suf38). One participant reported feeling uncomfortable being the only one in the workspace using an SSD,

particularly because he was sometimes the only person standing and, as a result, interacting with colleagues from a higher position. He admitted that this factor has at times compromised his levels of concentration at work (suf17). Other points mentioned included the difficulty of establishing a habit of using the SSD as well as the workload that complicated the transitions between sitting and SPs (suf32). One participant noted that experienced some initial resistance to using the SSD due to standing causing some visual discomfort, particularly in focusing the screen (suf11).

*Discomfort*

The data regarding the variable "Discomfort" reflects the responses to the question: "During the use of the sit-stand desk, did you experience any discomfort that made you sit down again?" The coding for the responses was: 0 = "No"; 1 = "Yes, which ones,". Participants who answered 1 were required to specify the discomforts experienced. During the intervention, 11 participants reported experiencing some form of discomfort related to the use of SSD at least once. Throughout the intervention, the participants reported: pain in the right shoulder (suf06), upper back pain (suf06, suf14), lower back pain (suf04, suf06, suf10, suf25), pain/fatigue in the legs (suf05, suf07, suf10, suf12, suf31), and pain in the feet (suf17, suf19).

In Table 2, the responses to the monthly satisfaction questionnaire from the 19 participants in the intervention group regarding the variables with qualitative components "Strategies", "Difficulties", and "Discomfort" are shown. The data was presented as the frequency of reports throughout the months of intervention.

***Semi-structured interviews***

The data collected from the semi-structured interviews resulted from the analysis of the testimonies of eight participants in the convenience sample, regarding their experience with the use of SSDs. The analysis of the testimonies revealed nine (9) mentioned themes: Acceptability; Habit; Health benefits; Health risks; Knowledge; Motivations; SSD characteristics; Social support; and Work routine. The thematic analysis reflects the line-by-line coding for each participant testimony. In Table 3, it is possible to see the number of files and references for each theme. The files reflect the number of participants who mentioned each theme, while the references indicate the number of times each theme was mentioned.

**Table 2 - Number of participants´ reports related to Strategies, Difficulties, and Discomfort when using SSD during the 6 months of intervention**

| | | Month | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| **Strategies** | At work | 7 | 8 | 10 | 7 | 6 | 7 |
| | Outside work | 10 | 10 | 9 | 7 | 10 | 9 |
| **Difficulties** | | 4 | 5 | 4 | 5 | 4 | 3 |
| **Discomfort** | Shoulder | 0 | 0 | 1 | 1 | 1 | 1 |
| | Upper back | 0 | 0 | 0 | 1 | 0 | 1 |
| | Lower back | 4 | 3 | 2 | 4 | 3 | 3 |
| | Legs | 3 | 1 | 1 | 3 | 3 | 1 |
| | Feet | 2 | 0 | 0 | 0 | 0 | 0 |

*Intrapersonal level*

***Acceptability.*** In response to the question, "How has your experience been using the sit-stand desk?", the participants answered, demonstrating their level of acceptance regarding the initiative undertaken. Most participants considered it a positive experience, easy to adapt to and easy to use, which they would like to maintain in the future, with one participant whose experience was affected by health reasons. The importance of the intervention in the work community was also reported.

*"The experience has been positive, I have enjoyed using the sit-stand desk and integrating it into our lives is easy"(suf07).*

*"The experience was good. I adapted well. I liked it" (suf10).*

*"I think I'm adapting well. I like the concept. It's something to continue with" (suf31).*

*"I always think the experience is positive because I tried something different" (suf04).*

*"It has been great; I have felt comfortable" (suf06).*

One participant's experience was affected by a health issue at the time of the interview, presenting a different perspective from the other participants:

*"The experience could have been more positive if it hadn't coincided with a time when I had a kind of sciatica pain, which prevented me from fully using the sit-stand desk. I wasn't able to benefit much because I also couldn't make much use of the sit-stand desk" (suf25).*

**Table 3 - Results of the coding performed on each testimony from the participants in the convenience sub-sample regarding the themes identified**

| Themes | Files | References |
|---|---|---|
| Acceptability | 8 | 14 |
| Habit | 8 | 10 |
| Motivations | 8 | 10 |
| Knowledge | 7 | 9 |
| SSDs characteristics | 4 | 8 |
| Health risks | 4 | 5 |
| Work routine | 3 | 3 |
| Health benefits | 2 | 4 |
| Social support | 1 | 1 |

Another participant reported her acceptance of the experience and expressed the importance of the intervention at the workplace:

*"It is a very positive strategy for those who use it. It is an excellent initiative to promote more regular physical activity among all employees" (suf06).*

***Habit.*** Since the beginning of the intervention, several participants have reported changes in their daily work habits motivated by the use of SSDs. Participants began alternating between standing and sitting time, with some choosing to take more frequent breaks, while others spaced out their interruptions of sitting time. It was also mentioned that standing made it easier to move around to
accomplish tasks outside the workspace. However, initial difficulties were revealed in adapting to the SSD and some inertia towards the new routine of using the SSD.

*"I ended up benefiting from the purpose of this, which was not to be sitting all the time. I stood up a few times, very few times, but I stood up" (suf04).*

*"I have been raising and lowering the desk more often, so I've been alternating between sitting and standing, which is great because this way I move more" (suf06).*

*"I usually stand up a little every hour and stay standing for 15 minutes" (suf12).*

*"During work, I always have my headphones on listening to music, so when standing, it's easy to adapt to the work, and if I can, I dance a little" (suf07).*

Spending more time standing was also mentioned as a facilitator during the work period when performing tasks:

*"On days when we have school management duties and have to walk around a lot, it's much easier to move from here than to keep sitting and standing up again. It's very practical" (suf07).*

The transition to working in a standing position when using the SSD was not easy for all participants:

*"At first, it's a bit difficult to adapt. It's different. It goes a bit against the norm of sitting" (suf31).*

For others, although adaptation occurred, other reasons led to less usage:

*"I'll be honest, I haven't used it much, but that's out of my own laziness, not because I didn't adapt to the model" (suf11).*

One participant expressed the opinion that adaptation and the creation of new habits also lie in the process of trying:
*"I think this is like everything in life; it's a matter of habit. And success comes exactly from that, whether we try or don't try" (suf10).*

***Health benefits.*** Some participants reported health benefits related to the use of SSDs during the usage period, namely in the improvement of posture and the relief of musculoskeletal discomfort.

*"I have noticed that every time I am standing, I have a much more upright posture" (suf11).*

*"Sometimes my feet hurt, my back hurts, and... then I stand up for a little while and feel better. It's going to be good for my health, yes. I think I feel less strain from standing up and sitting down" (suf12).*

***Health risks.*** During the intervention period, several participants noticed some discomfort/pain that affected their health and consequently their experience with the use of SSDs. There were instances where the pain resulted from using the SSDs, particularly in shoulder, elbow, and wrist. However, pre-existing musculoskeletal issues, particularly lower back pain, made their use difficult.

*"To work properly, I should have this part of my forearm supported, and with this device I don't, so my forearm is unsupported, which makes it quite difficult for my shoulder and wrist because I have tendinitis" (suf04).*

*"If this support for the mouse were larger, it would allow the person to have their arm supported. Sometimes, when I'm in this position for too long, since I have two screens, what happens is that my forearm starts to hurt" (suf06).*

*"Here at work, I stay seated more often because I had this kind of... I had this lower back pain that prevented me from using the sit-stand desk" (suf25).*

***Knowledge.*** All participants in the SUFHA intervention received an informative session about the problems associated with low levels of physical activity, as well as the harmful effects of high levels of SB. The participants reported an awareness of this reality, suggesting an influence on their use of the SSDs, as well as on their adaptation outside of work environments.

*"For example, on weekends, when I'm sitting for a long time, I already think two or three times about standing up once or twice, every now and then, so I'm not always sitting, which harms the spine and everything else" (suf04).*

*"There are many things that I naturally do standing up at home, like household chores, so it becomes easy to carry this strategy over to other contexts" (suf07).*

*"At home, sometimes my legs already hurt and I sit down. But I often remind myself to stand more" (suf12).*

*"I started taking walks during lunch, because I spend a lot of time sitting, and I realize that this has disadvantages for my health" (suf10).*

***Motivations.*** In response to the question "Do you think you would continue using the sit-stand desk after the study ends?", several participants expressed their opinions on whether they would like to continue using the SSD in the future or not. Most participants would like to continue using the SSD in the workplace as they consider it an important initiative for the staff. Other participants even expressed interest in acquiring one for home use. On the other hand, the difficulties experienced in adapting to the SSD, particularly due to its design, led one participant to mention that under these conditions, she would not like to continue using the SSD.

*"Yes, of course, I think they should really let us keep this desk, if only because we were the guinea pigs testing this new product. I think it's fantastic, and I would definitely like to use it again later, yes, without a doubt. I want one of these for myself." (suf06).*

*"I've even thought about it and have already started looking at prices to get one for myself." (suf07).*

*"That would be great... At the end of the study, it will be good for the university staff." (suf12).*
*"Maybe one day I'll be buying one of these for my house." (suf31).*

One participant did not show a willingness to continue using the SSD after the study due to its conditions:

*"I find it difficult under these conditions. If I had a bigger desk, I think I would, if I had space*

*to put other things and space to support my arm. If the conditions were different, yes, but in this context, I wouldn't want it anymore." (suf04).*

Another participant emphasized the importance of persistence and stepping out of one's comfort zone in order to participate in and benefit from the SSD intervention:

*"Fundamentally, what I think is important is for people to try. Because if we don't try, we won't know if we can adapt or not. It might be great for me, but for another colleague, it might not be. But there's nothing like trying; we have to step out of our comfort zone." (suf10).*

***Work Routine.*** Regarding the work routine, participants mentioned that there are days when it becomes more difficult to use the SSD due to the workload as well as the type of tasks they need to perform. Another participant reported having adapted to the new work routine, noticing differences, particularly in her increased productivity.

*"Sometimes there are days when it's not possible to make as many transitions from sitting to standing, but I spend more time standing, or more time sitting. However, most of the time, I raise and lower the desk frequently." (suf06).*

*"I think it's a good strategy for employees. Of course, it depends on each person and the type of tasks they do." (suf10).*

Another participant noticed changes in her work capacity when using the SSD in the standing position:

*"I noticed a bit more work speed. I ended up being faster... More productive." (suf11).*

*Interpersonal level*

***Social support***. A participant mentioned the importance of the intervention's influence on other colleagues who saw their peers using the SSDs:

*"It's also a positive strategy for colleagues who aren't using it, but whenever they pass by, they say they would also like to try it." (suf06).*

*Environmental level*

***SSDs characteristics***. One of the most frequently mentioned barriers by the participants was the design of the SSDs. Several considered that it was not practical or suited to the type of tasks they perform. The most mentioned issue was the lack of space on the platform, which affected workflow fluidity and also caused discomfort due to the lack of forearm support.

*"It would be much more beneficial if it were a larger desk where we had more space. I think it was more designed for people who use the keyboard a lot rather than those who work with papers. Because to work properly, I should have this part of my forearm supported, and with this device, I don't, so my forearm ends up unsupported." (suf04).*

*"If the mouse pad support were larger, it would allow the arm to be supported, because as it is, it isn't." (suf06).*

*"Maybe the platform could be different. We lose some useful workspace here." (suf10).*

*"I wouldn't continue using it in the future if it were like this, because we can't support our arms, and with our desks, we can. I think that's the big difference." (suf31).*

## III.4 Discussion

As two methods of data collection were implemented, the information from both will be analyzed as a whole, aiming to present as much information as possible provided by the participants in the intervention group.

Overall, the intervention involving the use of SSDs was well-received by the participants, aligning with evidence from systematic reviews (Torbeyns et al. (2014) and Neuhaus et al. (2014)). The participants reported that the intervention was easy to implement and an effective way to increase PA levels, as concluded by Graves et al. (2015) and Gradidge et al. (2022) respectively. As observed in table 2, of the nineteen participants in the intervention group, a maximum of five people reported difficulties in adapting to the use of the SSD. This information reflects the idea of a favorable acceptance of SDDs as a way to

reduce SB in the workplace among participants, as has been observed in the latest evidence (Deery et al., 2024).

Several participants reported changes in their daily habits both at work and outside as the intervention progressed, as noted in the monthly satisfaction questionnaire and semi-structured interviews. Some participants adopted strategies to reduce sitting time at work, consistent with findings from Biddle et al. (2020) and Brierley et al. (2022). Many participants raised and lowered the SSD more frequently, increasing movement. Some set a routine of standing for a short period each hour, while others alternated between twenty minutes standing and twenty minutes sitting. Others stood for tasks like responding to emails, making phone calls, or simply walking around the workplace. Being already standing was seen as beneficial when needing to leave the workstation, as they no longer had to stand up each time. One participant installed software to monitor SB, leading to greater awareness of time spent sitting versus standing. However, not all participants found the transition easy, with some, particularly early in the intervention, struggling to adjust due to their habitual sitting while working, as observed by Wilkerson et al. (2019). Outside of work, several participants also adopted strategies to increase physical activity. While eleven participants already engaged in regular physical activity, some took up walking during lunch breaks and reducing sitting time during leisure at home to continue supporting the intervention's goals. These testimonies confirmed the importance of raising participants' awareness regarding the reduction of SB in the workplace, which in some cases led to the transfer of this change in daily habits to leisure time and even at home. The intervention with SSDs in the workplace thus acted as a trigger, sparking the adoption of new, more active and consequently healthier behaviors and habits.

When it comes to health benefits related to the use of SSDs, few were mentioned by the participants. One participant reported a noticeable improvement in posture due to spending more time standing. She felt that she stood straighter compared to her previous posture, thanks to the standing position provided by the SSD. This perception of postural improvement aligns with the findings of Chau et al. (2014) and Gradidge et al. (2022). Another participant reported experiencing discomfort in her back when sitting for long periods while working. This discomfort was alleviated by transitioning to a standing position, which made her feel less tense. Such improvements in musculoskeletal symptoms were also noted in the works of Edwardson et al. (2023), Hadgraft et al. (2017), and Dutta et al. (2015).

One of the barriers for using the SSDs was the associated health risks. Several participants mentioned that the desk's design caused them discomfort, hindering its usage. Discomfort related to the lack of arm support was mentioned, with participants reporting shoulder, elbow, forearm, and wrist pain, as observed by Hadgraft et al. (2017). However, from the analysis of the monthly satisfaction questionnaire, it was observed that eleven participants reported some form of discomfort at least once, with lower back pain and leg fatigue/pain being the most frequent, in line with the findings of Brierley et al. (2022), and Graves et al. (2015).

All participants in this study have jobs that partially or fully require a desk. As they are accustomed to working in a seated position, switching to a standing position demands different energy expenditure as well as postural adjustments inherent to the new stance. Assuming the SSD model is suitable for all participants, we must, however, consider participant variables such as weight, height, and pre-existing health conditions, which may compromise the experience of using the SSD. In this particular study, this issue was evident.

At the start of the SUFHA intervention, participants attended a psychoeducational session on the benefits of reducing and interrupting sitting time with standing and other activities, as well as a demonstration of SSD use and ergonomic guidance (Júdice et al., 2023). This preparation helped participants engage more easily with the intervention and may have influenced the development of new routines. One participant mentioned being more mindful of standing at home to avoid prolonged sitting, while another found it easy to apply the strategy of reducing sitting time at home. A third participant adopted the habit of walking during lunch breaks to mitigate the health risks of extended sitting. One of the limitations identified in the studies by Graves et al. (2015) and Grunseit et al. (2013) was that participants reported lacking the necessary knowledge on how to adjust the SSD position to prevent injuries resulting from improper use. However, based on the analysis of the testimonies from participants in the SUFHA study, this issue was not observed. The participants attended an initial informational session on the benefits of reducing SB, and they were provided with guidance on how to operate the standing desk according to proper ergonomic practices. This support provided by the intervention coordinators serves as a facilitator for the efficient use of the SSD, as well as raising awareness about the importance of reducing SB.

Overall, most participants showed a favourable acceptance of the implementation of the SSDs in the workplace during the intervention. When asked about the possibility of using the SSDs in the future at their workplace, many expressed motivation towards that prospect.

One participant even showed interest in purchasing one for personal use at home. Among those who demonstrated greater acceptance of the experience, their motivations aligned with the three themes proposed by Chau et al. (2014): Experimenting with something new; Interest in potential health benefits, and relevance to the participant's own and organization's work.

With the start of the intervention, participants developed new routines both inside and outside of work aimed at reducing SB. As mentioned earlier, strategies were adopted to make more transitions from sitting to standing position. However, these transitions were often constrained by the established work routine. Some participants highlighted that on certain days, the volume of work does not allow for as many transitions from sitting to standing, as shown by Wilkerson et al. (2019). Others pointed out that not all work tasks can be easily completed while standing as seen in Edwardson et al. (2023) and Gradidge et al. (2022). This highlighted a limitation related to the type of work performed and the nature of certain tasks, which sometimes acted as a barrier to greater use of the SSD in the standing position. With this in mind, it would be interesting for future interventions to include prior knowledge on the part of the researchers regarding the type of work each participant performs. This would allow them to advise on when it would be most feasible to carry out tasks while standing, thus facilitating and guiding the participant towards more effective use of the SSD. Nevertheless, one participant reported noticing a greater speed of work and productivity when working in a standing position, reality also presented by Renaud et al. (2020).

Another issue was presented by a participant who was the only one in his workspace with a SSD. He reported feeling uncomfortable being the only person working while standing, as he had to communicate from a higher position. This occasionally affected his concentration levels at work, as seen in Henderson et al. (2018). Although this issue was only mentioned by one participant, it may prove relevant to the dynamics within the workplace. Standing while working alone in an office can present a different challenge compared to standing in a room with more colleagues who are seated. For the purposes of this study, not all university employees received SSDs. However, envisioning the implementation of this strategy in a workplace where everyone uses SSDs could help minimize this discomfort associated with the new routine.

Studies such as those by Renaud et al. (2018), and Wilkerson et al. (2019), emphasized the importance of verbal support from coworkers as an encouragement to use the SSD. The authors also pointed out that the mere fact of seeing other colleagues standing can influence and motivate others to do the same. In this study, only one participant mentioned a

reference to this theme, likely due to the absence of questions related to this topic in both the monthly satisfaction questionnaire and the semi-structured interview. However, the participant in question expressed that using the SSD in a standing position sometimes attracted the attention of colleagues from other departments, which encouraged them to want to try it out as well. This reality seems crucial for the successful implementation of SSDs in the workplace. Studies such as those by Wilkerson et al. (2019), Hadgraft et al. (2017), and Dutta et al. (2015) found that having other colleagues adopt this change in behavior appears to have a contagious effect on other workers, promoting greater use of SSDs. Biddle et al. (2020) also found that group sessions or catch-up sessions can provide a good opportunity to share experiences, ask questions, and set goals, creating a positive competitive environment and contributing to increased use of SSDs.

The design of SSDs is often cited in the literature as one of the main barriers to their use. In this study, participants reported that the design features of the SSD were the biggest challenge to their experience. The most frequently mentioned issue was the size of the platform that supports the computer, as noted in studies by Wilkerson et al. (2019), Henderson et al. (2018), Brierley et al. (2022), Graves et al. (2015), Edwardson et al. (2023), Biddle et al. (2020), and Dutta et al. (2015). According to the participants in this study, there was limited workspace, especially for those who needed to work with papers, making it more practical for those who only used the keyboard, an observation also noted by Biddle et al. (2020). The lack of space was also noticed because it made arm support difficult, leading to pain or discomfort in the shoulder, elbow, and wrist. Another issue mentioned by two participants regarding the design was the difficulty in lifting the platform to the standing position due to the weight of the computer. Although only seven participants reported limitations, five of these were related to the design of the SSD, which aligns with what the literature has consistently shown. If we observe what most studies related to the use of SSDs point out, the design of SSDs has proven to be one of the main barriers to greater and better usage. Future approaches should take into account the size of the platform, as it allows workers to perform their tasks without compromising due to a lack of space. In addition to space for the keyboard and mouse support, future designs should feature a platform with space for those performing handwritten tasks and who need to have paper documents on the desk. They should also consider the weight of the computer and adapt mechanisms that allow the platform to be raised and lowered without causing discomfort to workers.

In line with the purpose of the study, and after analyzing the testimonies of the participants in the SUFHA intervention, we can consider that: The themes of Health benefits, Knowledge, Motivation, and Social Support were generally seen as facilitators for the use of SSDs; The themes of Health risks and SSD Characteristics were considered barriers to the use of SSDs; The themes of Habit and Work routine were sometimes perceived as barriers and other times as facilitators for the use of SSDs.

The evidence has shown studies with qualitative approaches to interventions using SSD (SSDs), with the majority of these conducted in the USA, UK, and Australia. Looking at the results of this study, we can see that they are in line with the existing literature in the field. This reality suggests that the cultural, linguistic, and population differences between the countries mentioned above and Portugal do not reflect significant differences regarding the topic addressed in this study. Knowing this, strategies to improve interventions using SSDs can be applied on a global scale, as similar barriers and facilitators to the use of SSDs have been identified in Portugal and other countries.

## III.5 Strengths and Limitations

This study has the strength to be the first qualitative study concerning perceptions of SSD use by participants in interventions conducted in Portugal. One of the difficulties encountered was the quality of the information collected via video in the semi-structured interviews. When transcribing the interview testimonies into written information, it is important to consider each participant's speaking speed and their diction, which, in some cases, made the transcription task more challenging. The background noise, verified in some testimonies, may interfere with the audio collection. These two factors should be considered in future intervention studies.

It would have been relevant to collect more information, encompassing the three levels of the socio-ecological model, regarding the participants' perceptions of the SSD experience, which would result in a more detailed qualitative evaluation of the intervention. However, this did not happen due to SUFHA comprising a wide range of primarily quantitative data analysis, with less qualitative components.

Nevertheless, this study has the strength of revealing participants' opinions regarding the intervention, contributing to future studies by considering the barriers and facilitators to the use of SSDs.

## III.6 Conclusions

This study is the first qualitative research conducted in Portugal regarding participants' perceptions of SSDs use in interventions and aligns with existing evidence, confirming participants' acceptance of interventions when implementing SSDs as a strategy to reduce SB in the workplace.

Participants' testimonies revealed how easily new work routines were created and extended to leisure and home settings, with the SSD intervention promoting more active and healthier behaviors. The initial guidance from SUFHA researchers raised awareness of sedentary risks and ensured proper SSD use. Although few health risks were noted, future interventions should adopt a more individualized approach to prevent conditions from hindering SSD use. A better understanding of workers' tasks could also provide more accurate advice on balancing sitting and standing.

New approaches should focus on selecting SSDs designs, as this was frequently identified as a barrier in the literature and confirmed by participants' feedback. SSDs should combine a more spacious work platform that does not hinder workflow with a mechanism that facilitates easy height adjustment to help minimize the pain and discomfort reported by participants.

Supervisors and coordinators of workspaces should consider in future interventions the importance of social support, as verbal support from colleagues and group sessions can help address challenges arising from the intervention and establish new strategies and goals for increased SSD use.

Future studies should incorporate qualitative data collection methods focused on the intrapersonal, interpersonal, and environmental spheres of participants' experiences with using SSDs, to encompass all aspects of the intervention, and thereby providing a clearer understanding of the major barriers and facilitators to SSD use, and contribute to the implementation of SSDs in the workplace as a means of reducing SB.

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# CHAPTER IV

## IV.1 General Discussion

The qualitative findings of the original study align with the conclusions from the systematic review, revealing a general acceptance of SSDs by participants as a mean to reduce SB in the workplace, as observed by Neuhaus et al. (2014) and Torbeyns et al. (2014). Participants in the SUFHA study even reported that the experience was very positive, motivating them to continue using SSDs and possibly even purchase one for home use.

The monthly satisfaction questionnaire, through the variable "Strategies," revealed that many participants, during the SUFHA intervention, adopted new habits both at and outside of work to integrate the concept of reducing sitting time, which is consistent with the findings of Biddle et al. (2020) and Brierley et al. (2022). Some chose to use the SSD more frequently, others preferred to stand at fixed times of the day and work while standing for some time, showing the individual nature of these interventions, where each participant seeks to adapt the intervention's goal in a way that feels most comfortable. It was also noticeable that participants chose to engage in physical activity, both at and outside of work. Some preferred walking during work hours or lunch breaks, while others felt motivated to exercise outside of working hours. However, one participant mentioned a point highlighted by Wilkerson et al. (2019), which was the difficulty in changing their working posture due to the natural habit of sitting.

Some SUFHA study participants also referred a point mentioned by Wilkerson et al. (2019), noting that on certain days, the workload did not allow for adequate SSD use. Moreover, they also mentioned that "not all work tasks can be easily completed while standing," as seen in Edwardson et al. (2023) and Gradidge et al. (2022).

The knowledge provided by the study leaders on how to use the SSDs and the benefits of reducing SB were also cited as facilitators during the intervention, as participants felt more aligned with the study's aim and had a better understanding of how to use the SSD.

The health benefits reported by participants in the SUFHA study were also supported by evidence. Improvements in posture and relief from musculoskeletal discomfort were observed, as noted by Chau et al. (2014), Gradidge et al. (2022), Dutta et al. (2015), Hadgraft et al. (2017), Biddle et al. (2020), Gradidge et al. (2022), and Edwardson et al. (2023). However, when looking at the "discomfort" variable from the monthly satisfaction questionnaire and the testimonies of participants from the convenience sub-sample, the

presence of pain/discomfort following SSD use was noted, particularly in the shoulders, lower back, legs, and feet, as observed by Dutta et al. (2015) and Wilkerson et al. (2019) and further corroborated by Wilkerson et al. (2019) and Edwardson et al. (2023), as well as Graves et al. (2015) and Brierley et al. (2022).

In both the original study and the systematic review, the topic of "SSDs characteristics" was frequently reported by participants. In the original study, through the analysis of the "difficulties" variable and the interviews, several participants addressed the design of SSDs as a barrier to their use. Factors such as the limited space of the platform and the mechanism itself were seen as obstacles to the correct use of the SSD, even compromising the health of some participants who reported shoulder, forearm, and hand pain, as observed in Edwardson et al. (2023) and Hadgraft et al. (2017).

Looking at the barriers and facilitators identified in both studies of this thesis, it is evident that the themes of "Access," "Supporting Factors," and "Workplace norms/culture" were not identified in the original study but only in the systematic review, while the theme of "social support," though mentioned in the original study, did not play as significant a role as it did in the systematic review. This observation demonstrates one of the points mentioned in the strengths and limitations section of the original study, which relates to the fact that no approach was taken to involve the intrapersonal, interpersonal, and environmental spheres when gathering participants' testimonies.

Although the original study employed two data collection methods, it did not manage to encompass all aspects of the intervention necessary to fully assess participants' perceptions of the SUFHA intervention. The theme of "Access" somewhat limits the theme of "motivations," in the sense that, despite some participants' desire to continue using SSDs, the cost was prohibitive if they had to purchase them themselves. From a perspective of investing in workers' health, companies should consider investing in SSDs, thus preventing participants from bearing large costs and fostering a standing work culture that contributes to employees' health and, consequently, greater productivity, a notion also expressed by Graves et al. (2015), Brierley et al. (2022), and Gradidge et al. (2022).

Several interventions reported the existence of "supporting factors" as noted by participants. Some participants used digital reminders, which were seen as a positive and useful strategy, helping combat forgetfulness in using the SSD, as noted by Wilkerson et al. (2019), facilitating the establishment of a new routine that maximized standing time at work. It was also helpful to set personal goals for using the SSD and to review progress throughout

the intervention (Biddle et al. 2020). However, some participants ended up investing in equipment that would enhance their standing experience, such as comfortable footwear and anti-fatigue mats, as analyzed by Dutta et al. (2015), Henderson et al. (2018), and Wilkerson et al. (2019). This strategy, adopted by participants in these interventions, should be considered for future interventions, as it could help advisors recommend such measures to make the experience less monotonous, more challenging, and even foster positive competition among workers.

Each workplace has its own pre-established norms and rules. Some participants in the interventions mentioned in the systematic review raised this topic as sometimes limiting the use of SSDs because certain workspaces did not have a culture of standing work as natural. Therefore, it becomes important to normalize the concept of standing work and to promote more dynamic and, consequently, less sedentary workplaces. It is up to supervisors in these workplaces to foster this culture and even lead by example, creating a contagious atmosphere around this concept so that workers feel more comfortable working while standing, both in their workspace and in meetings with higher-level supervisors.

Social support was a topic rarely addressed by participants in the SUFHA study, which contrasted with what the evidence had presented. Studies like those by Renaud et al. (2018) and Wilkerson et al. (2019), as well as Dutta et al. (2015) and Hadgraft et al. (2017), revealed that social support was fundamental during interventions. The simple fact that one colleague was using the SSD sometimes led another to do the same, in a kind of contagious action. Verbal support was also observed at times, serving as a stimulus between supervisor and worker. Maybe the low number of participants for each cluster may explain these differences. Future interventions should encourage the exchange of ideas and SSD usage experiences through meetings, allowing for the sharing of intervention perceptions and promoting the setting of goals, targets, and challenges aimed at greater SSD use and, consequently, reduced SB.

This thesis provides a comprehensive approach to the most recent evidence regarding the analysis of qualitative data from interventions using SSDs. The original study, through thematic analysis and qualitative data collection via the monthly satisfaction questionnaire, sought to identify the main barriers and facilitators to SSD use by participants in the SUFHA intervention. New interventions should consider an approach that encompasses all aspects of the intervention, allowing for more complete participant perceptions to be collected, thus

contributing to the establishment of solid evidence in favor of SSD implementation in the workplace.

## IV.2 General Conclusions

Although the evidence does not yet present many qualitative studies on interventions using SSDs, various methodologies were observed during the systematic review. Several barriers and facilitators to the use of SSDs were highlighted by the evidence regarding participants' perceptions, offering new ideas for more effective future approaches.

Looking at the testimonies of participants in the interventions and having identified the barriers and facilitators regarding the experience of using SSDs, we realized that participants are exposed to many factors that make the use of SSDs an individual and unique experience. Age, weight, height, presence of chronic conditions, and each participant's level of physical activity are variables that can influence their experience with SSDs. The type of tasks performed at work, social support from colleagues and supervisors, and health literacy are also examples of factors that vary between participants, potentially leading to different outcomes and perceptions of the intervention. Future interventions should, therefore, adopt individualized strategies for each worker, considering their characteristics, job functions, and expectations regarding SSD use, in order to make the experience more personalized and in this way increase effectiveness.

This work highlights, both through the systematic review and the original study, the importance of SSD design. Seen as one of the most frequently reported barriers by participants, it had repercussions on both the acceptance and on health risks and the motivation to continue using it in the future. New designs should combine an SSD with an appropriate platform for tasks involving a keyboard, such as writing and document organization, ensuring good support for the forearm so that it does not remain unsupported. They should also feature a practical and functional mechanism for adjusting the height of the platform, thus not compromising the flow of work.

This study confirmed that the collection of qualitative data is influenced by the inherent study methodology, making it necessary to ensure the quality of testimonies collected via audio, video, and questionnaires. New approaches should encompass the participants' interpersonal, intrapersonal, and environmental spheres, so that the data

represents a more accurate reflection of the reality and captures the participants' true perceptions.

This thesis can be a valuable contribution to the application of the scientific method, encompassing the areas of workplace ergonomics and workplace SB, aiming to address an increasingly sedentary lifestyle, particularly in the workplace. Most qualitative studies on interventions using SSDs are conducted in English-speaking countries (USA, UK, Australia), making the original study a significant contribution to the evidence, as it was conducted in Portugal, a non-English speaking country. Despite the cultural, population, and financial differences between Portugal and other countries, this study demonstrated that the perceptions of the SUFHA study participants were in line with those reported in the systematic review. This reality shows that, in quite different contexts, similar difficulties were noted and similar benefits were pointed out with the use of SSDs, suggesting that future interventions could adopt measures to improve participants' experiences on a global scale.

Future interventions can reference this study, considering the barriers and facilitators identified, to design safer and more effective SSD interventions, thereby contributing to the creation of less sedentary and, consequently, healthier workplaces.

## IV.3 References

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# CHAPTER V

# Annexes

# Annex V. 1

## Quality Appraisal of included studies


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CASP Checklist: 10 questions to help you make sense of a Qualitative research
How to use this appraisal tool: Three broad issues need to be considered when appraising a qualitative study:

- Are the results of the study valid? (Section A)
- What are the results? (Section B)
- Will the results help locally? (Section C)

The 10 questions on the following pages are designed to help you think about these issues systematically. The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions. There is some degree of overlap between the questions, you are asked to record a "yes", "no" or "can't tell" to most of the questions. A number of italicised prompts are given after each question. These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.
About: These checklists were designed to be used as educational pedagogic tools, as part of a workshop setting, therefore we do not suggest a scoring system. The core CASP checklists (randomised controlled trial & systematic review) were based on JAMA 'Users' guides to the medical literature 1994 (adapted from Guyatt GH, Sackett DL, and Cook DJ), and piloted with health care practitioners.

For each new checklist, a group of experts were assembled to develop and pilot the checklist and the workshop format with which it would be used. Over the years overall adjustments have been made to the format, but a recent survey of checklist users reiterated that the basic format continues to be useful and appropriate.

Referencing: we recommend using the Harvard style citation, i.e.: *Critical Appraisal Skills Programme (2018). CASP (insert name of checklist i.e. Qualitative) Checklist. [online] Available at: URL. Accessed: Date Accessed.*

CASP
Critical Appraisal Skills Programme

Paper for appraisal and reference: .....

## Section A: Are the results valid?

1. Was there a clear statement of the aims of the research?

Yes ☐
Can't Tell ☐
No ☐

HINT: Consider
- what was the goal of the research
- why it was thought important
- its relevance

Comments:

2. Is a qualitative methodology appropriate?

Yes ☐
Can't Tell ☐
No ☐

HINT: Consider
- If the research seeks to interpret or illuminate the actions and/or subjective experiences of research participants
- Is qualitative research the right methodology for addressing the research goal

Comments:

## Is it worth continuing?

3. Was the research design appropriate to address the aims of the research?

Yes ☐
Can't Tell ☐
No ☐

HINT: Consider
- if the researcher has justified the research design (e.g. have they discussed how they decided which method to use)

Comments:

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4. Was the recruitment strategy appropriate to the aims of the research?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider
- If the researcher has explained how the participants were selected
- If they explained why the participants they selected were the most appropriate to provide access to the type of knowledge sought by the study
- If there are any discussions around recruitment (e.g. why some people chose not to take part)

Comments:

5. Was the data collected in a way that addressed the research issue?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider
- If the setting for the data collection was justified
- If it is clear how data were collected (e.g.focus group, semi-structured interview etc.)
- If the researcher has justified the methods chosen
- If the researcher has made the methods explicit (e.g. for interview method, is there an indication of how interviews are conducted, or did they use a topic guide)
- If methods were modified during the study. If so, has the researcher explained how and why
- If the form of data is clear (e.g. tape recordings, video material, notes etc.)
- If the researcher has discussed saturation of data

Comments:

CASP
Critical Appraisal Skills Programme

6. Has the relationship between researcher and participants been adequately considered?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider

- If the researcher critically examined their own role, potential bias and influence during (a) formulation of the research questions (b) data collection, including sample recruitment and choice of location
- How the researcher responded to events during the study and whether they considered the implications of any changes in the research design

Comments:

## Section B: What are the results?

7. Have ethical issues been taken into consideration?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider

- If there are sufficient details of how the research was explained to participants for the reader to assess whether ethical standards were maintained
- If the researcher has discussed issues raised by the study (e.g. issues around informed consent or confidentiality or how they have handled the effects of the study on the participants during and after the study)
- If approval has been sought from the ethics committee

Comments:

CASP
Critical Appraisal Skills Programme

8. Was the data analysis sufficiently rigorous?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider
- If there is an in-depth description of the analysis process
- If thematic analysis is used. If so, is it clear how the categories/themes were derived from the data
- Whether the researcher explains how the data presented were selected from the original sample to demonstrate the analysis process
- If sufficient data are presented to support the findings
- To what extent contradictory data are taken into account
- Whether the researcher critically examined their own role, potential bias and influence during analysis and selection of data for presentation

Comments:

9. Is there a clear statement of findings?

| | |
|---|---|
| Yes | |
| Can't Tell | |
| No | |

HINT: Consider whether
- If the findings are explicit
- If there is adequate discussion of the evidence both for and against the researcher's arguments
- If the researcher has discussed the credibility of their findings (e.g. triangulation, respondent validation, more than one analyst)
- If the findings are discussed in relation to the original research question

Comments:

CASP
Critical Appraisal Skills Programme

## Section C: Will the results help locally?

10. How valuable is the research?

| | |
|---|---|
| Yes | |
| No | |
| Can't Tell | |

HINT: Consider

If the researcher discusses the contribution the study makes to existing knowledge or understanding (e.g. do they consider the findings in relation to currentpractice or policy, or relevant research-based literature

- If they identify new areas where research is necessary
- If the researchers have discussed whether or how the findings can be transferred to other populations or considered other ways the research may be used

Comments:

# Annex V.2

## Parecer do comité de Ética do estudo SUFHA

UNIVERSIDADE LUSÓFONA
I Faculdade de Educação Física e Desporto

### Comissão de Ética da Faculdade de Educação Física e Desporto -ULHT

### Parecer D0522

A Comissão de Ética da Faculdade de Educação Física e Desporto – ULHT, em reunião de 5 de Dezembro de 2022, analisou o projeto *The impact of introducing sit-stand desks in the workplace for healthy aging: a randomized controlled trial in sedentary adults*, com o acrónimo designado por *SUFHA (Stand Up For Healthy Aging)*, a realizar por quatro centros de investigação (Centro Investigação em Desporto, Educação Física, Exercício e Saúde -*CIDEFES* da Faculdade de Educação Física e Desporto; Centro de Investigação em Comunicação Aplicada, Cultura e Novas Tecnologias - *CICANT*- da Escola de Comunicação, Arquitetura, Artes e Tecnologias da Informação, *COW* - Centro de Investigação em Design e Arte - Center for Other Worlds, e *HEI-LAB* – Human Environment Interaction laboratory), cujo investigador principal é o **Pedro Júdice**, tendo decidido emitir parecer positivo sem recomendações.

O Diretor da Comissão de Ética da FEFD – ULHT

(Prof. Doutor José Gregório Viegas Brás)