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# The risks of sedentary work & prolonged sitting and the effects of physical activity in the workplace

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**Abstract:** In recent decades office work and “cubicle farms”, as they are known, have gained traction and become a prominent part of the work place in many developed nations. These workplaces are designed with little thought to the fact that movement and physical activities are crucial aspects of human health. What comes along with this is the increase in the sedentary aspects of work, namely sitting. Many employees find themselves sitting in their office chairs for hours on end each day with few breaks. Accumulating this much time sitting at a desk throughout the weeks, months, and years of a person’s working life can have serious adverse effects on health and well being. Research in the last decade has shown that increased sedentary behavior can increase risk factors for many chronic illnesses and all-cause mortality [1]. More specifically research has shown an association between long periods of sedentary behavior and type 2 diabetes, cardio-metabolic disease, and weight gain [1]. Increased sitting time is the main mechanism of this increased sedentary behavior, yet surprisingly research has not found a clear link between occupational sitting and adverse musculoskeletal health outcomes [2-11, 13-15]. In light of the increase in sedentary office work many researchers have been studying various interventions aimed at decrease sedentary time and increase physical activity in the workplace. Studies involving sitting vs. standing desks, increased step counts, and incentivized physical activity programs have been viewed as possible solutions for these pertinent problems [22]. The purpose of this research is to explore the various risks associated with sitting and sedentary work as well as the effects of interventions aimed at increasing physical activity in an occupational setting.

**Keywords:** Workplace, Occupation, Sitting, Sedentary, Knee Symmetry, Physical Activity, Health, Well Being, Risks.

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## 1. Introduction

As of late, the developed world has seen an increase in sedentary office-based work. Research has shown an increase in sedentary work of up to 20% in the past 5 decades [18]. Other developed nations have seen results consistent with these as well. For instance, a French study found that on average workers spend about 10h/day sitting on workdays and 7.58h/day sitting on non-workdays with a strong positive correlation between sedentary behavior at work and sedentary behavior during leisure time [20]. This increased contribution of sedentary time in the workplace has the potential to decrease caloric expenditure which over time can very possibly lead to weight gain and a myriad of other health problems [18].

Another concern that people have had with this increased sedentary time is the effect that prolonged sitting has on the body. However, the effects of prolonged sitting may not be as bad as most people think. Various studies have found that there is no direct causal relationship between occupational sitting and lower back pain [6-8]. Other studies have noted an increase in wrist, arm, and neck pain but have cited a lack of evidence linking this directly to seated posture [12-15]. The majority of this upper body musculoskeletal pain is associated with the use of a computer [13,14].

Overall, the main concern found in this review is with increased sedentary time in general. Advances have been made in the implementation of physical activity programs in the workplace and more research is being done to find effective interventions that don’t take away from being at work. Things such as increased step count programs and standing workstations have been viewed as potential solutions and this review aims to look at their effectiveness.

## 2. Methods

A comprehensive review of the literature was done by performing a search of the PubMed database of the National Library of Medicine, National Institutes of health, and the National Center for Biotechnology. For an effective search the keywords workplace, sedentary, exercise, physical activity, sitting, office, intervention, and wellbeing were mixed, matched, and searched. A search for the risks of sedentary work was also conducted using key words such as sedentary, sitting, health risks, and health effects was also conducted. For this review a database of over 350 articles was considered, and only those specific to sedentary behavior in the workplace and articles specific to prolonged sitting in an occupational setting were evaluated.

## 3. Risks of Sitting and Sedentary Work

### 3.1. Risks of Prolonged Sitting

A variety of sources in the past decade have posed a link between sedentary behavior and a multitude of adverse health outcomes. These include cardiovascular and metabolic health risks such as weight gain and possibly the risk of obesity [2]. In addition to these concerns there is also some inconclusive evidence stating that prolonged sitting could lead to premature mortality and obesity [3]. For instance, a meta-analysis performed by Chau and associates [4], using data from “595,086 adults and 29,162 deaths over 3,565,569 person-years of follow-up,” in 2013 concluded that 10+h/day of sitting increased mortality rate up to 34%, and this is after adjusting for physical activity. Chau’s team [4] also found an increase in all-cause mortality of up to 5.9% across the population after adjusting for physical activity. However, this research does not focus specifically on occupational sitting and its effects, and most jobs only require a portion of the 10+ hours of sitting that was needed to see a significant statistical increase in mortality. In a different analysis Chau et al. [5] used data from 10,785 Australian workers and found a less than clear correlation between occupational sitting and obesity. Although Chau’s team [5] found a positive correlation between leisure sitting and weight gain there was no clear relationship between occupational sitting and weight gain.

There has also been great concern for the musculoskeletal health of office workers participating in prolonged sitting. A study performed by Baker and associates [6] found that out of 20 test subjects sitting for 2 hours acute lower back pain increased to clinically significant levels in 95% of test subjects. However, research done by Van Nieuwenhuyse et al. [7] and Hartvigsen et al. [8] has not found strong causal evidence that prolonged sitting in the workplace can lead to an increase in back discomfort, if not pain, specifically in the lower back. Using a population of 278 workers under the age of 30, with no history of back pain episodes, in a nine-year study, it was found that only 23% of study participants developed lower back pain, but could not find a relationship between sitting time and back pain [8]. A similar study performed by Balling and associates [9] could not find any significant relationship between back pain and occupational sitting. This study was carried out by surveying a population of 57,504 Danish workers over the age of 18, and based on self-reported values of sitting [9]. Laboratory research suggests, however, that there is in fact an increase in lower limb discomfort, which, is due to an increase in lower limb swelling [10,11,12]. Winkel et al. [10] found that out of all of their subjects there was a 4% increase in foot and lower limb swelling and pain with an 8-hour sitting period when compared to subjects who were tasked with active sitting. This study suggests that just adding light to moderate activity in the lower limbs could alleviate pain and swelling cause by long periods of sitting [10]. This swelling is most likely due to minimal leg activity as well as pressure put on the thighs and buttocks during sitting which decreases venous return [6]. This in turn causes swelling, which can lead to pain. A small-scale study of Swedish workers, in which subjects were seated for 90 minutes also concluded that a period of prolonged sitting mainly increased perceived discomfort in the buttocks, thighs and knees, while there was no significant relationship between back pain and sitting [12].

As for the upper body there isn’t a strong positive correlation for any serious health risks [12]. This is of course unless you consider the use of a computer, which could lead to things such as carpal tunnel, deQuervain's tendonitis, or chronic wrist tendonitis in general [12]. A study performed by Gerr et al. [13] using 632 computer workers with  $\geq 15$ h/wk of seated computer time found that over 50% experienced neck and arm pain within 12 months. Most of this pain was found to be in the tendons of the wrist, which can be contributed more to computer work than sitting alone [13]. Congruently, a systematic review of 63 studies concluded that sitting and performing computer work led to an increase in hand and wrist discomfort but noted a lack and evidence supporting a relationship between prolonged sitting exclusively and upper arm/shoulder discomfort [14]. This review concluded that the biggest cause of biomechanical health risks in the work place came with

strenuous physical work and smoking [14]. Also conforming with these results was an observational study performed by Korhonen et al. [15]. This study followed 180 Finnish administrative computer workers for a period 12 months. The results of this study showed an average 34.4% increase in neck pain; however, this was not specifically attributed to sitting or sedentary behavior, but rather to poor keyboard placement, and poor overall work environment [15]. This study also concluded that physical activity could reduce this pain [15].

### 3.2. Risks of Generalized Sedentary Work

It has been well documented that in general a decrease in physical activity and an increase in sedentary behavior of all types can lead to increased health risks such as weight gain, increased mortality, and cardiovascular health risks [1,2,9]. There is also concern about the contribution of office work to sedentary time. Studies have found that the prevalence of sedentary work has increased by at least 20% in the past 5 decades in the United States with a consistent decline in physically active professions [18]. Using statistics from the Current Employment Statistics Program from the years 1960-2008 Church et al. [18] discovered an average decrease in calorie expenditure of 100cal/day in American workers over the course of 50 years. Church and associates [18] also figured that this decrease in caloric expenditure accounts for a significant proportion of mean body weight increase seen in American men and women in the past 50 years. A study in Australia had 50 office workers wear fitness trackers during waking hours for a seven-day period [19]. The results of this study were compatible results found by Church et al. [18] as it was discovered that sedentary time accounted for 81.8% of time spent in the workplace, which was significantly higher than sedentary time spent outside of work [19]. It was also found that an average of 76% of waking time on workdays was spent sedentary [19]. This study was able to conclude that time spent at work was a significant contributor to overall time spent in a sedentary state [19].

The effects of this increased sitting time were illustrated in a study by Kazi et al. [21]. This study included 10 worksites in the UK with 8 involved in telecommunications, profession that requires long sedentary periods, and 2 sites were public sector professional occupations [21]. Of these 10 worksites 1,120 employees were included in the study [21]. The result of this study was that the telecommunication workers had a significantly higher BMI, resting heart rate and, a significantly higher waist circumference [21]. This was greatly attributed to the fact that these workers spent 60% of their daily sitting time in the work place with 66% of their time in the workplace spent seated [21]. After seeing these results one can infer that private sector office workers are an important target for workplace physical activity interventions

## 4. Physical Activity Interventions

### 4.1. Effects of Physical Activity Interventions

In recent years a number of researchers have been exploring the viability of various workplace physical activity interventions. The majority of these studies include something simple and cost effective such as increases in light activity through increased step counts. The effects of these programs usually find results ranging from decreased musculoskeletal discomfort at work to a control in weight gain and one study finding that an exercise intervention increased employee energy and vigor during the workday [22-24,27]. Freitas-Swerts and Robazzi [22] performed a research study in which 30 administrative workers were put on a plan where they exercised for 15 minutes a day twice a day for 10 weeks at work. The average resting heart rate for these employees was 67BPM [22]. Exercises performed included muscular chain stretching and targeted postural stabilization exercises, and the average heart rate increase for these exercises was 40/BPM higher than the average resting heart rate [22]. After 10 weeks the data showed a significant decrease in musculoskeletal discomfort and pain and an overall increased feeling of wellbeing [22]. A second study found results congruent with this. This research included 200 female workers who were in two separate groups; one group was given a home exercise plan and one group was given a supervised workplace exercise plan [23]. Both groups exercised 5 times per week for 10 weeks [23]. After the study was through this study also found that exercise reduced overall musculoskeletal pain [23.] Another interesting finding of this study was the fact that the work group experienced slightly more improvement in pain and soreness than did the home group leading to the conclusion that a supervised at work exercise regimen was more effective than at home exercise [23].

Researchers in one study utilized 704 Spanish office workers as subjects, and tried a "Sit less, move more" program where breaks for light physical activity and short walks were included throughout the day [24]. This continued for 19 weeks, and at the end of the study it was found that workers had significantly increased activity related energy expenditure in participating employees [24]. While it was found that this program did not meet the daily-recommended physical activity for health benefits it did result in employees burning an

average of 17,011kcal over the course of the day [24]. Studies have shown that 90% of adult weight gain can be prevented by the additional burning of 100kcal/d so this increase in light physical activity could help to combat the risks of sedentary behavior in the workplace [24,25,26,27]. Similar to these results, other researchers have found that an incentivized plan to increase step count throughout the day did significantly increase physical activity of employees and was incredibly cost effective at that [28]. Another less researched intervention is the use of treadmill and cycle desks. A small meta-analysis of these studies found that these methods are an effective way to combat the risks of sedentary work however more research needs to be done to see if this intervention method is cost effective [29].

However, despite these results not all interventions are created equal. One such intervention is the sit-stand workstation [30]. A large study performed by Hall concluded that after 12 months there was no difference in physical activity or health measures between sitting workstations and standing workstations [30]. While standing does increase calorie expenditure it does not do so to a significant amount [30]. One possible use for the standing workstation is reduced incidence in back pain for those already at risk of lower back pain or suffering from back pain [30]. A study, which only included 29 participants, was set up to examine the possible benefits of sit stand work stations by allowing employees to use them consistently over the course of a 4-week period [31]. The conclusion was that standing desks can decrease the chances of lower back pain to those who are already at risk, but other than that standing workstations don't give a significant health advantage [31].

## 5. Summary and Practical Applications

Through this review it was found that the risks of sitting have not been directly linked to any sort of physical ailment, however, working in a sedentary environment does decrease caloric expenditure and can lead to weight gain and the problems which come with it. An increase in physical activity, even just light physical activity, can have a significant impact on musculoskeletal health of workers and can help prevent weight gain associated with sedentary behavior. Certain interventions such as including stretching and postural activities can reduce skeletal muscle discomfort [22]. Light activity such as walking is cost effective for employers and increases caloric expenditure, which in turn helps to fight weight gain [24, 25, 26]. Cycling and treadmill desks are effective at increasing physical activity, however, these interventions can be expensive to implement [31]. This said, employers could apply this information by implementing the opportunity for their workers to perform light exercise during the workday. Breaks for short walks or having employees take the stairs are both ways to increase physical activity with little cost. Incentives would be a great way to have employees stick to their exercise plans [27]. While the effects of exercise in health are well documented more research is warranted on the specific effects and effectiveness of workplace interventions. Areas of future research should include the cognitive impacts of workplace physical activity. The cost feasibility and the willingness of employees to adhere to physical activity regimens in the office are also points of interest that should be studied further. This would paint a clearer picture of the best possible ways to implement physical activity interventions in the workplace.

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