Original Article

Vol. 7, No. 2, 69-75
https://doi.org/10.15280/jlm.2017.7.2.69

Journal of Lifestyle Medicine

Adverse Effects of Prolonged Sitting Behavior on the General Health of Office Workers

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Background: Excessive sitting behavior is a risk factor for many adverse health outcomes. This study aimed to survey the prevalence of sitting behavior and its adverse effects among Iranian office workers.

Methods: This cross-sectional study included 447 Iranian office workers. A two-part questionnaire was used as the data collection tool. The first part surveyed the demographic characteristics and general health of the respondents, while the second part contained the Nordic Musculoskeletal Questionnaire (NMQ) to assess symptoms. Statistical analyses were performed using the Statistical Package for the Social Sciences software using Mann-Whitney U and Chi-square tests and multiple logistic regression analysis.

Results: The respondents spent an average of 6.29 hours of an 8-hour working shift in a sitting position. The results showed that 48.8% of the participants did not feel comfortable with their workstations and 73.6% felt exhausted during the workday. Additionally, 6.3% suffered from hypertension, and 11.2% of them reported hyperlipidemia. The results of the NMQ showed that neck (53.5%), lower back (53.2%) and shoulder (51.6%) symptoms were the most prevalent problem among office workers. Based upon a multiple logistic regression, only sex had a significant association with prolonged sitting behavior (odds ratio = 3.084). Our results indicated that long sitting times were associated with exhaustion during the working day, decreased job satisfaction, hypertension, and musculoskeletal disorder symptoms in the shoulders, lower back, thighs, and knees of office workers.

Conclusion: Sitting behavior had adverse effects on office workers. Active workstations are therefore recommended to improve working conditions.

Key Words: Musculoskeletal diseases, Sedentary lifestyle, Workplace

INTRODUCTION

Modern workplaces have shifted the nature of occupations from active to sedentary and promote lengthy sitting behavior. One cause of this change is the transition from paper-based work to computerized and paperless work [1].

Office workers are part of a large group of occupations that generally work in a sitting position for much of the day [2]. These people remain in a sitting posture for about two-thirds of their working hours, and their bouts of sitting periods typically last at least 30 minutes [3,4].

In 2008, about 25% of all United States jobs had a sedentary nature, while this percentage was only 15% in 1960 [1]. An Australian study revealed that 42% of men and 47% of

Received: June 13, 2017, Accepted: July 12, 2017

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women spend an average of 6.3 of their 8-hour shifts in sedentary and sitting jobs [5]. Also, in the Netherlands, about 50% of working adults report that they maintain a sitting posture for four or more hours each working day [6].

Sedentary behavior has been defined as "any behavior characterized by an energy expenditure of ≤1.5 METs while in a sitting or reclining posture" [7]. Sedentary and sitting behavior in office workplaces is a risk factor for cardio-metabolic disease, type 2 diabetes, obesity, coronary artery disease, musculoskeletal disorders [8], some types of cancer, and premature death [9,10].

The results of Church et al.'s (2011) study revealed that the average energy expenditure of individuals while at work declined from 1960-2010. This shift in occupational energy expenditure has been associated with a decrease of 100 calories per day, which in turn account for as much as 80% of the average increase in body weight among the working population during this same period [1]. Based on Atkin and Wannameth's study (2015), overweight and obesity are major public health problems with an increasing prevalence worldwide, and are also risk factors for cardiovascular morbidity and mortality in an adult population [11].

The findings of some studies indicated that for each two-hour increment in sitting time, the risk of obesity and diabetes increases by 5% and 7%, respectively [12]. In contrast, prolonged sitting behavior raises the risk of musculoskeletal disorders, especially low back pain [13]. Additionally, the findings of Gianoudis et al.'s study revealed that a greater overall sitting time is associated with an increased risk of sarcopenia, which climbs by 33% for each one-hour increment of sitting [14]. Other studies have shown that sedentary occupations are associated with a higher risk of developing some types of cancers, such as colorectal, ovarian, prostate, and endometrial cancer [15-17].

Another outcome of a sedentary lifestyle is premature death. The World Health Organization (WHO, 2013) estimates that 3.2 million people worldwide die prematurely each year due to a sedentary lifestyle [18]. Studies have shown that people who spend almost all of their working time in a sitting position have a 1.4-times greater chance of premature death after 12 years than their counterparts who sit for less time at work [19].

In contrast, an active lifestyle improves one's general health and decreases the risk of chronic diseases [20]. It has been reported that active rest bouts between prolonged sitting periods are associated with beneficial metabolic profiles in adults and also decreased waist circumference, body mass index (BMI), triglyceride levels, and two-hour plasma glucose levels [21].

Recently, health guidelines in Australia [22] and Britain [23] have been published that recommend adults from 18-64 years old decrease their daily amount of sitting time. However, in Iran, there are not yet proper recommendations for reducing sedentary and sitting behaviors in office workers. Therefore, this study aimed to survey the prevalence of sitting behavior and its adverse effect among office workers of the Shiraz University of Medical Sciences and recommend solutions.

MATERIALS AND METHODS

Office workers with at least one year of job tenure (n = 447) participated in this study, which was conducted at Shiraz University of Medical Sciences (SUMS). Employees with a history of any diseases or accidents (such as occupational and road accidents) that could affect the musculoskeletal system were excluded from the study.

1. Data-gathering tools and study procedure

An anonymous, self-administered questionnaire was used to collect the required data from each participant. The questionnaire contained two parts:

(a) Personal details (including age, weight, height, job tenure, daily working time, sex, marital status, education, smoking status, daily exercise, and so on).

(b) The general Nordic Musculoskeletal Questionnaire (NMQ) to assess symptoms and examine reported cases of musculoskeletal disorders (MSDs) in different body regions among the study population [24]. Reported musculoskeletal symptoms were limited to the past 12 months.

Each participant received the questionnaire to complete in person at his or her workplace.

2. Statistics

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 16.

Mann-Whitney U and Chi-square tests were used to examine the univariate associations between different variables. A multiple logistic regression analysis was performed for each outcome while also retaining the variables in the models to adjust for potential confounders. In the regression analysis, if the p-value of the Chi-square test for the association between the variables and the sitting time in a working day was ≤0.25, the variable was included in the regression model (inclusion criteria) [25].

RESULTS

Table 1 summarizes the personal details of the participants. Table 2 presents the possible adverse effects related to prolonged sitting times. The prevalence rates of musculoskeletal symptoms in different parts of the body in the past 12 months among the participants are shown in Table 3. The results of the NMQ revealed that neck (53.5%), lower back (53.2%), and shoulder (51.6%) symptoms were the most prevalent problems reported by office workers in the past 12 months.

1. Factors associated with sitting time during a working day

In general, the statistical analyses showed that the sitting time during a working day was significantly associated with demographic and occupational variables (age, BMI, job tenure, sex, marital status, educational level, and workstation comfort). The included factors for sitting time during a work day are the result of multiple logistic regression analysis performed to adjust for potential confounding.

Our analysis revealed that sex was the only main variable retained in the regression model, with an odds ratio of 3.084

Table 1. Demographic information about the participants in the study (N = 447)

Quantitative variable		Mean ± Standard deviation
Age (years)		36.65 ± 7.71
Weight (kg)		69.97 ± 13.04
Height (cm)		168.23 ± 9.67
BMI (kg/m^2)*		24.64 ± 3.71
Job tenure (years)		12.11 ± 7.23
Working hours per day		8.49 ± 1.6
Time spent sitting per workday		6.29 ± 1.9
Hours of exercise per week		2.16 ± 3.62
Qualitative variable		**No. (%)**
Sex	Male	199 (44.7%)
	Female	246 (55.3%)
Marital status	Married	111 (25.1%)
	Single	331 (74.9%)
Educational level	Associate's Degree and lower	84 (19.0%)
	Bachelor of Science and higher	358 (81.0%)

BMI: Body mass index.

Table 2. Possible adverse effects related to prolonged sitting times in the studied office workers (N = 447)

Possible adverse effects related to prolonged sitting times		No. (%)
Smoking	Yes	9 (2.0%)
	No	438 (98.0%)
Workstation comfort	Yes	221 (49.8%)
	No	223 (50.2%)
Carelessness on the job	Yes	27 (6.0%)
	No	420 (94.0%)
Error repetition	Yes	11 (2.7%)
	No	435 (97.3%)
Exhaustion during the workday	Yes	329 (73.6%)
	No	118 (26.4%)
Impatience	Yes	148 (33.1%)
	No	229 (66.9%)
Job satisfaction	Yes	282 (63.1%)
	No	165 (36.9%)
Heart disease	Yes	17 (3.8%)
	No	430 (96.2%)
Respiratory diseases	Yes	20 (4.5%)
	No	426 (95.5%)
Hypertension	Yes	28 (6.3%)
	No	419 (93.7%)
Hyperlipidemia	Yes	50 (11.2%)
	No	397 (88.8%)
Diabetes type 2	Yes	17 (3.8%)
	No	430 (96.2%)
Digestive diseases	Yes	46 (10.3%)
	No	401 (89.7%)
Depression	Yes	31 (7.0%)
	No	415 (93.0%)
Migraine	Yes	44 (9.8%)
	No	403 (90.2%)
Pituitary gland disorders	Yes	2 (0.4%)
	No	445 (99.6%)
Thyroid disorders	Yes	35 (7.8%)
	No	412 (92.2%)
Parathyroid disorders	Yes	0 (0.0%)
	No	447 (100.0%)
Adrenal gland disorders	Yes	1 (0.2%)
	No	446 (99.8%)
Sexual dysfunction	Yes	7 (1.6%)
	No	440 (98.4%)

Table 3. Frequency of reported musculoskeletal symptoms in different body regions during the past 12 months in the studied office workers (N = 447)

Body region	Number of participants with symptoms
Neck	239 (53.5)
Shoulders	230 (51.6)
Elbows	63 (14.1)
Wrists/Hands	178 (39.9)
Upper back	196 (43.8)
Lower back	238 (53.2)
Thighs	84 (18.8)
Knees	188 (42.1)
Feet and ankles	144 (32.2)

(1.785-5.331). This finding indicated that among all variables included in the regression, sex had a significant association with sitting time during a workday.

2. Adverse effects of prolonged sitting times on office workers

The results of the Mann Whitney U test showed that prolonged sitting times among office workers could have effects on exhaustion during a working day, job satisfaction, hypertension (blood pressure above 140/90 mmHg), and MSD symptoms in the shoulders, lower back, thighs, and knees of office workers ($p < 0.05$) (Table 4).

Table 4. Adverse effects of prolonged sitting times among the studied office workers (n = 447)

Variable		Mean ± Standard deviation of sitting time	p-value*
BMI	Underweight/ Normal weight	6.19 ± 1.98	0.263
	Overweight/Obese	6.45 ± 1.95	
Exhaustion during the workday	Yes	6.51 ± 1.80	<0.001
	No	5.69 ± 2.28	
Job satisfaction	Yes	6.18 ± 1.96	0.035
	No	6.50 ± 1.97	
Hypertension	Yes	7.31 ± 1.92	0.024
	No	6.23 ± 1.96	
Shoulder pain	Yes	6.50 ± 1.88	0.024
	No	6.06 ± 2.05	
Low back pain	Yes	6.70 ± 1.74	<0.001
	No	6.05 ± 2.05	
Thigh pain	Yes	6.50 ± 1.87	0.016
	No	6.06 ± 2.06	
Knee pain	Yes	6.72 ± 1.69	0.014
	No	6.20 ± 2.02	

**Mann Whitney U test.*

DISCUSSION

As shown in Table 1, the participants worked in a sitting position for an average of 6.29 hours during an 8-hour working shift. It was found that women sat longer than men (6.47 vs. 6.07 hours/day, respectively). Our study also revealed that the participants had an average exercise time of 2.16 hours per week. The results showed that 48.8% of office workers did not feel comfortable with their workstations and 73.6% were exhausted during their working day. In addition, 6.3% of the studied workers suffered from hypertension and 11.2% reported hyperlipidemia.

The NMQ revealed that neck (53.5%), lower back (53.2%) and shoulder (51.6%) symptoms were the most prevalent problem among the office workers in the past 12 months.

Sex was the only main variable retained in the regression model, and it had a significant association with the amount of sitting time during a working day. This finding indicated that the chance of sitting behavior among female workers was 3.084 times higher than that of their male colleagues. In contrast, Wallmann-Sperlich et al. conducted a study in Germany (2013) that showed that men sat longer than female office workers [26]. This discrepancy can be attributed to differences between the nature of jobs in these two studied populations.

The results of our statistical analysis indicated that prolonged sitting times among office workers could have an effect on exhaustion during the working day, job satisfaction, hypertension (blood pressure above 140/90 mmHg), and MSD symptoms in the shoulders, lower back, thighs, and knees of office workers.

The findings of Picavet et al. revealed that hypertension in their participants was related to occupational sitting behavior. In addition, the results of this same study (Picavet et al.) indicated that about one-third of the surveyed individuals had hypertension [27].

Other studies have shown that reducing one's energy expenditure and the lack of localized excitation-contraction of muscles that results from a prolonged sitting position can

cause suppression of lipoprotein lipase activity. The activity of lipoprotein lipase is critical for the attraction of triglycerides and the production of high-density lipoprotein cholesterol. Prolonged sitting additionally reduces insulin secretion, interferes with the uptake of blood glucose by skeletal muscles [28] and may also increase proinflammatory cytokines, which are associated with the development and progression of many cardiovascular disorders [29].

The findings of previous studies have demonstrated that musculoskeletal problems in different body regions, especially in the upper limbs, neck, shoulders, and low back, of office workers are common [30]. Generally, the prevalence of MSDs has been reported to range from 40-80% among office workers [31]. This high rate of MSDs in different regions of the body of office workers can be attributed to awkward and static postures as well as repetitive movements.

Although our results indicated that there was no significant association between sitting time and BMI, the mean amount of sitting time among overweight and obese participants was higher than that of underweight and normal weight respondents. In this context, Chu et al.'s study showed that sitting behavior was associated with adverse effects on abdominal obesity and hypertriglyceridemia [32]. An increase in weight among office workers can also be linked to a reduction in energy expenditure.

According to the findings of the present study, the use of active workstations for decreasing sitting time and its adverse effects would be beneficial for the office worker population. Based on Pronk, walking workstations, cycling workstations, portable stepping devices, portable pedal exercise machines, elliptical machines, physical activity breaks, prompting software, skip-stop elevators, and sit-stand workstations all have a positive effect on the general health of users because they increase their active behaviors. These workstations cause decreased sitting times, increased energy expenditure, positive effects on health markers, positive effects on work performance, no acute effect on cognitive function, and no straightforward findings concerning computer task performance [33].

Based on our surveys, sit-stand workstations are an appropriate and practical selection for Iranian office work. In the United States, Europe and Australia, sit-stand workstations are used to reduce sitting time by up to 143 minutes in a workday [34]. However, some factors, including organizational structure, physical environment, interpersonal communication, and intrapersonal factors (such as attitude) may also be involved in reducing the sitting time [35,36]. In addition, the use of height-adjustable workstations has caused office workers to sit less (40-66 fewer minutes per day); symptoms of musculoskeletal disorders in the upper limbs among users was reduced, while their precision of duty, productivity, mood, and moral sense improved [37].

Modification of workplaces using sit-stand workstations is a useful way to decrease the sitting time of office workers. Some studies have shown that these workstations decrease the risk of death related to cardiovascular disease. Additionally, increasing the number of working posture variations while using adjustable sit-standing workstations decreases the symptoms of MSDs caused by prolonged sitting and repetitive motion, reduces swelling in the legs, decreases exhaustion, and increases energy expenditure among office workers [38].

However, it should be pointed out that an appropriate schedule for changing from a sitting to a standing position must be followed because sitting and standing postures may cause pain in the lower limbs [39]. In a sitting position, the spine deviates from a normal shape to an S-shape, causing extra pressure on the spine but less pressure on the lower extremities. In contrast, in a standing position, the spine retains its normal shape and bears less pressure, but the lower extremities receive more biomechanical pressure due to the body's weight [40]. As long as these considerations are kept in mind, sit-stand workstations can reduce the harm of both positions.

Since the data used in this study were obtained using a self-report methodology, the findings should be cautiously interpreted. In addition, because this study was carried out among office workers at the Shiraz University of Medical Sciences, its results may not be generalized to other workplaces and working groups. This study was the first survey in this field among Iranian office workers. The results of this study can be used in future investigations to provide proper guidelines for developing appropriate sit-stand schedules.

ACKNOWLEDGEMENTS

This article is a part of the thesis written by Mr. Hadi Daneshmandi, PhD candidate of Ergonomics at SUMS, and was financially supported by SUMS Grant No. 95-01-104-11387.

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