UNIVERSITI MALAYSIA PAHANG

ORIGINAL ARTICLE

The impact of risk factors associated with long-term computer use on musculoskeletal discomfort among administrative staff: A case study

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ABSTRACT – Work-related musculoskeletal diseases (WMSDs) are on the rise as a result of excessive usage of desktop computers. People use computers in the office for communication, word processing, data processing, record keeping, and project management, among other applications. This study aimed to determine the prevalence of musculoskeletal discomfort (MSD) and related risk factors among university workers. This study explores the association between the severity of body discomfort and affected activities such as daily living and work. This study focused on musculoskeletal discomfort among support staff at University Malaysia Pahang who works in the office. There is 50 support staff (58 percent were females; 47 percent were males) who participated in this cross-sectional study. Nordic Musculoskeletal Questionnaire (NMQ) was used to gather data on personal characteristics, occupational conditions, and the prevalence of WMSDs. The intensity of pain was assessed using a Visual Analogue Scale (VAS). This study found four body regions with the most pain experienced by office workers: neck, shoulders, upper back, and low back. The individual risk factors related to musculoskeletal discomfort are age, weight, and height. The occupational risk factors that are most significant are working experience, daily computer use, and virtual meetings during work from home (WFH). Work and leisure activities are the most affected by the pain experienced by the respondents. In terms of work aspects, this study determined that job performance is the most significantly affected due to musculoskeletal discomfort. This study gives office workers some awareness of risk factors related to musculoskeletal discomfort during prolonged computer use and prolonged sitting. Providing prolonged computer use guidelines to reduce musculoskeletal discomfort among office workers is highly recommended.

INTRODUCTION

Modern office work has shifted the nature of occupations from being active to sedentary. As a result, office workers are prone to excessive sitting [1]. Computer overuse has been linked to increasing WMSDs among office workers [2]. One of the reasons for this concern is the transition from paper to computer work.

Bad positioning of the computer screen, keyboard or mouse and the wrong chair and table design may appear to aggravate musculoskeletal diseases in employees who use computers [3]. Although there are several studies related to WMSDs among office workers, there is still a definite need to delve deeper into this complicated connection, particularly between exposure to various risks and the resulting consequences [4][5]. The information obtained from this study might be used to give knowledge about WMSDs and the importance of a home working environment to improve office workers' mental and physical health [6].

This study was carried out on nine body parts based on the Nordic Body Map, such as the neck, shoulders, upper back, elbows, wrists or hands, low back, hips or thighs, knees, and ankles or feet [7]. Currently, at Universiti Malaysia Pahang (UMP), there is no scientific study among support staff to address the impact of risk factors associated with long-term computer use on musculoskeletal discomfort. Hence, this study aims to analyze WMSD risk factors and identify whether they are present or not among support staff at UMP, as well as the severity of the condition.

This study aims to determine the risk factors in individuals' musculoskeletal systems using computer devices and prolonged seating.
  i. To explore the relationship between pain severity of body discomfort and affected activity in daily living.
  ii. To identify the relationship between pain severity of body discomfort and affected work aspects.

LITERATURE REVIEW

Work-related Musculoskeletal Disorders (WMSDs)

Around three centuries ago, the pioneer of occupational medicine, Bernardino Ramazzini, an Italian physiciarecognizedsed the relationship between employment and certain musculoskeletal issues produced by irregular movements and the adoption of unpleasant posture in 1717 [8]. WMSDs are inflammatory and degenerative conditions affecting the muscles, tendons, ligaments, joints, peripheral nerves, and blood vessels [9]. Like other biological systems, the musculoskeletal or locomotor system may be physicalcharacterizedsed and functionally examined. The lower extremities sustain the body's weight and enable ambulation. They must be properly aligned and stable. The upper extremities facilitate self-care, nutrition, and work by reaching, grasping, and holding objects which need to be able to move around and be strong [10].

Damage or dysfunction can cause everything from modest aches and pains to more significant medical concerns that require time off or medical care [11]. They can also lead to impairment and the need to stop working in more severe circumstances WMSDs can harm any region of the body. They are clinically diagnosed illnesses, such as carpal tunnel syndrome or tenosynovitis; yet, many people experience non-specific symptoms, particularly non-specific back discomfort [12].

Musculoskeletal diseases and disorders disrupt anatomy and interfere with function. WMSDs may have a wide range of effects on the body, including the upper and lower back, neck, shoulders, and extremities [13]. The risk of WMSD rises when joints are operated outside of this mid-range frequently or for lengthy periods of time without enough recovery time [14]. During the COVID-19 epidemic, musculoskeletal and psychological problems have risen [15]. Thus, this study might help the office workers to be more concerned about their health issues.

Consequences of Prolonged Computers Use

Computer are increasingly being used for both professional and personal purposes [16]. Screen-based media, such as cell phones and computers, has a detrimental impact on health and quality of life. Excessive computer usage has been linked to a sedentary lifestyle, and a sedentary lifestyle can lead to musculoskeletal problems [17]. Excessive time spent on screen-based activities can raise the risk of neck and shoulder discomfort [18].

Sitting in front of a computer and manipulating it with a mouse or keyboard are the most basic office duties. Regardless of how innocuous these actions appear to be they do create the environment for problems to grow over time. This situation gets more dangerous when performed for lengthy periods of time every day. A previous study found that the most common musculoskeletal complaint was neck discomfort, followed by upper-extremity pain in-office employees who use computers too long [19]. Musculoskeletal issues are classified as public health issues since they are acute, persistent, and recurrent [7].

WMSD symptoms were common among computer users [20]. Poor body posture at the workstation, frequent use of keyboard and mouse, forearm support use, and force exerted on the wrist are factors that also tend to WMSDs due to prolonged computer use [21]. Excessive use and sitting in front of a computer can lead to psychological issues[22]. Ultimately, the number of hours spent on computers each day was linked to the occurrence of musculoskeletal condition symptoms. Sedentary behavior has been related to excessive computer use. Excessive screen time might increase the likelihood of neck and shoulder pain. The most prevalent musculoskeletal complaint was neck discomfort, followed by upper-extremity pain in office workers who spend too much time on computers. Figure 1 explains the percentage of pain due to prolonged computer use.

Figure 1. Percentage of pain due to prolonged computer use (Adapted from Habibzadeh, 2018) [22]

METHODOLOGY

This study employed two techniques to determine the risk factors associated with prolonged computer use, including the Nordic Musculoskeletal Questionnaire (NMQ) and Visual Analogue Scale (VAS). The NMQ was utilized to identify the musculoskeletal discomfort symptoms among the support staff that works in the office. Meanwhile, the VAS was used for determining the level of pain severity among employees. Both techniques collect data by sending the survey through sending the Google Form link to the email and WhatsApp Application participants. The other alternative is by distributing the hardcopy Google Forms to the support staff. A clear description of the study's substance and goal have been explained to the participants before answering the survey. The method for achieving the study objective is illustrated in Figure 2.
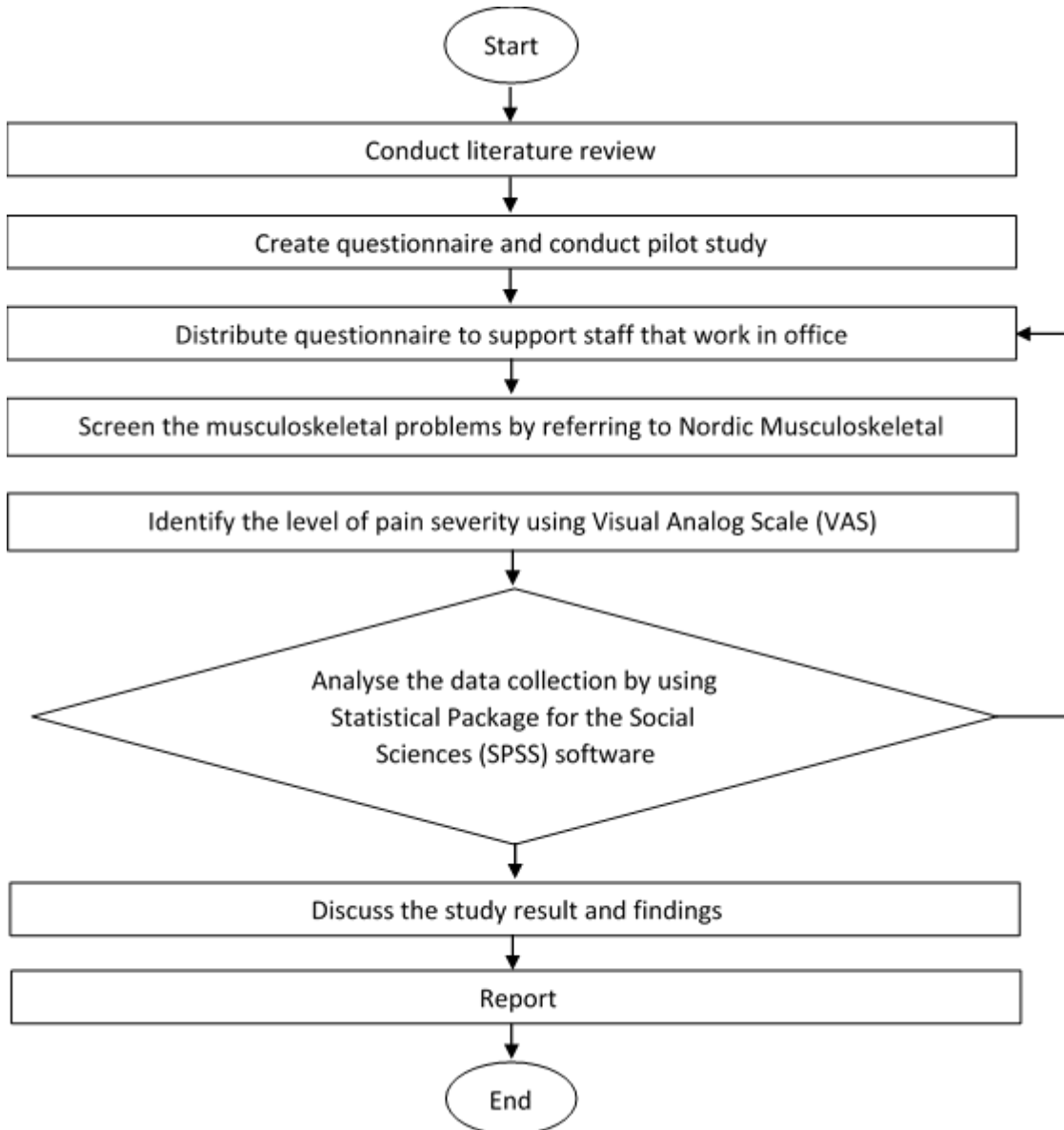

Figure 2. Research flow for the study of the impact of risk factors associated with long-term computer usage

Nordic Musculoskeletal Questionnaire (NMQ)

This study employed the Nordic Musculoskeletal Questionnaire (NMQ) to investigate WMSD symptoms among UMP support staff. NMQ is a standardized question that is required for the analysis and identification of musculoskeletal complaints of various persons in different regions of the world utilizing indirect approaches [23]. The NMQ is a feature of the human body is that commonly impacted by WMSDs, which are separated into 9 anatomical areas as shown in Figure 3. It is a simple question, with "yes" and "no" reflecting the existence or absence of WMSDs, respectively. For instance, in the last 12 months and last 4 months, participants were asked if they felt any pain at any part of the 9 body areas indicated in the questionnaire.

In this study, the participant also been asked whether they have been hospitalized, change jobs or duties even temporarily, prevented from doing normal work, seen a doctor or other such person, taken medication, or taken sick from leave due the problem. Respondents' characteristics (sociodemographic factors) such as gender, age, weight, and height were also enquired about. Besides, respondents' workplace characteristics (occupational factors) need to be collected to investigate the consequences of the behaviors or habits. The NMQ survey takes about 5 minutes to answer all the questionnaires.
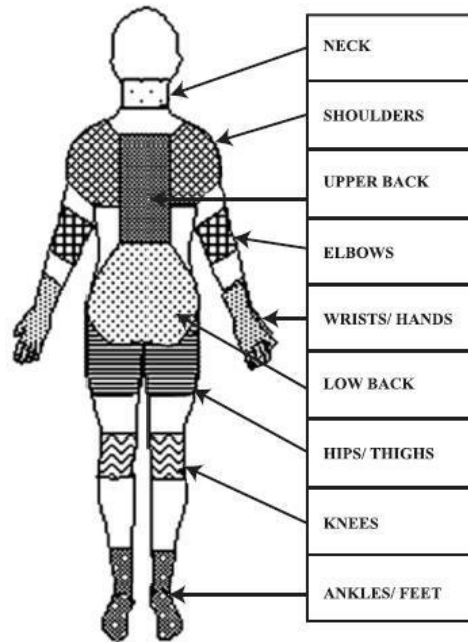

Figure 3. Nordic Body Map (Adapted from Prakoso et al., 2019) [24]

Visual Analog Scale (VAS)

Visual analogue scales (VAS) are psychometric measuring tools used to capture the features of illness-related symptom severity in individual participant and utilize this information to classify symptom severity and disease management in a quick (statistically quantifiable and repeatable) manner [25]. The participant that experienced the critical body part discomfort will be contact for joining this VAS survey. Table 1 shows the VAS scores for pain severity for every single part they feel discomfort. The scale was stratified into 4 groups; starts from 0 until 10 which the higher the score, the higher the pain severity.

Table 1. VAS score pain severity

Scale	Rate of pain
0	No pain
1-3	Mild pain
4-6	Moderate pain
7-9	Severe pain
10	Worst pain

Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software because this software can ease the process of data handling. The level of inconvenience caused by musculoskeletal discomfort in daily life was an outcome variable with numerous risk factors that include respondents' personal characteristics data and workplace characteristics due to prolonged computer use and prolonged sitting among respondents. The level of statistical significance was considered to be a p-value < 0.05. The correlation coefficient (r-value) can range from -1.0 to 1.0. In other words, the numbers cannot be more than 1.0 or less than -1.0. A correlation of -1.0 represents a perfect negative correlation, whereas a correlation of 1.0 represents a perfect positive correlation.

RESULT AND DISCUSSIONS

Respondent background

In this study, 50 employees working as support staff at Universiti Malaysia Pahang (UMP) volunteered to participate. Table 2 shows the data regarding the participants' personal characteristics, which are considered sociodemographic factors that may influence musculoskeletal discomfort. This study found that more females (60%) participated than males (40%) in this current survey. Most respondents are between 31 and 40 years old (58%). About 48% of the respondents' height ranged between 151 to 160 cm, and their weight ranged between 60 to 79 kg (42%).

Table 2. Personal characteristics (sociodemographic factor) of the participants

Characteristics	Frequency	Percentage (%)
Gender		
Male	20	40
Female	30	60
Age (years)		
21 – 30	11	22
31 – 40	29	58
41 – 50	8	16
51 >	2	4
Weight (kg)		
< 60	16	32
60 – 79	21	42
80 – 90	9	18
100 >	4	8
Height (cm)		
141 – 150	2	4
151 – 160	24	48
161 – 170	15	30
171 >	9	18

Table 3. Workplace characteristics (occupational factor) of the participants

Characteristics	Frequency	Percentage (%)
Campus		
Pekan	35	70
Gambang	15	30
Working experience (years)		
< 1	2	4
1 – 5	13	26
6 – 10	12	24
11 >	23	46
Daily working (hours)		
6 – 10	47	94
11 – 15	3	6
16 – 20	0	0
21 – 24	0	0
Daily computer or laptop use during work (hours)		
< 5	9	18
5 – 10	41	82
11 – 16	0	0
17 >	0	0
Daily external keyboard use (hours)		
1 – 5	19	38
6 – 10	29	58
11 – 15	2	4
16 – 20	0	0
Use external mouse		
Yes	49	98
No	1	2
Average daily virtual meeting during work from home (WFH)		
< 2 times per day	32	64
3 – 5 times per day	18	36
6 times and above per day	0	0

Characteristics	Frequency	Percentage (%)
Breaks sufficient		
Yes	32	64
Somewhat	15	30
No	3	6

The data relating to workplace characteristics that consider occupational factors are presented in Table 3. Based on the data, the majority of the respondents are from campus Pekan (70%) and most of them have more than 11 years of work experience (46%). There are 94% of the respondents work between 6 to 10 hours per workday while the other 6% is between 11 to 15 hours. Almost 82% of the respondents use the computer between 5 to 10 hours per day while the other 18% use computer less than 5 hours per day. The data state that the percentage of the daily external key in for a range of 6 to 10 hours is 58% per day. Most of the respondents (98%) use an external mouse to ease their work.

Based on the data collection, there are 64% of the support staff have less than 2 times of virtual meetings during work from home (WFH) and got sufficient breaks. However, there is 6% of them do not have a sufficient break due to the high workload. A previous study has found that too short rest periods increase the risk of musculoskeletal discomfort among computer users [9]. The author also stated that rest breaks relieve the computer user from issues arising from continuous computer work such as fatigue, poor blood circulation, and inflammation of musculoskeletal structures.

Distribution of Musculoskeletal Discomfort

Referring to Figure 4, this study analyses that the most critical body part that experienced ache, pain, or discomfort over for the past 12 months are the neck (78%), shoulder (72%), upper back (64%), and low back (62%). Figure 4 also shows that the most affected body regions in the last four months were the same as during the previous 12 months, with the neck (66%), shoulder (66%), low back (66%), and upper back (58%) resulting from prolonged computer use and prolonged sitting. The most body part that does not feel pain for the last 12 months and 4 months is the elbow which is 10% and 8% respectively. For the past 4 months, the prevalence of neck pain decreased from 78% to 66% but the low back increased from 62% to 66%. In this study, the correlation between musculoskeletal discomfort factor and pain duration of past 12 months data has been used for analysing. Basakci Calik et al. [2] stated that being examined for a long prevalence period of 12 months reflects a more realistic result.
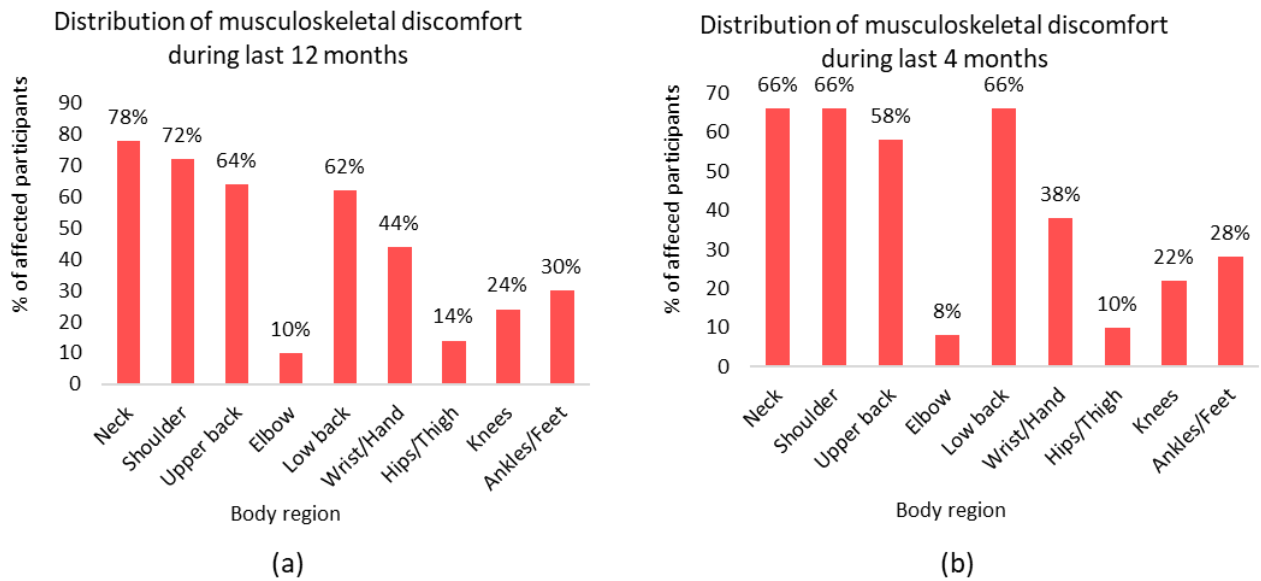

Figure 4. Distribution of musculoskeletal discomfort during last 12 and 4 months

Referring to Table 4, 4% of the respondent has been hospitalized due to musculoskeletal discomfort, and 28% of them have just seen a doctor to follow up on the pain. There are 54% of the respondent which is more than half of them had taken sick leave from work when experiencing the pain. Ultimately, 10% of the respondents decided to change duties even temporarily when having WMSDs trouble while the other 90% proceed to continue the same duties.

In this study, after all the data has been completely collected, the actual value will be transformed into a continuous. As result shown in Figure 5, most of the participants experienced moderate pain when having musculoskeletal discomfort, especially in the neck (48%), shoulder (46%), upper back (48%), and low back (52%). This result is supported by Condrowati et al., [26], research study that the fourth highest region of the body that experienced musculoskeletal disorder was the neck, shoulder, lower back, and upper back with ranges between 31% and 65%. Besides, the researcher claimed during work from home, the sitting position has the potential to induce upper and lower back pain.

The data in Figure 5 shows that there are only two body parts; the wrist/hand and the knees having the worst pain but with a low percentage of respondents which is 2% respectively. There is a higher percentage of participants experienced no pain in the elbow (58%), wrist/hand (44%), hips/thigh (56%), knees (44%), and ankles/feet (42%).

Table 4. Consequences due to musculoskeletal discomfort among respondents

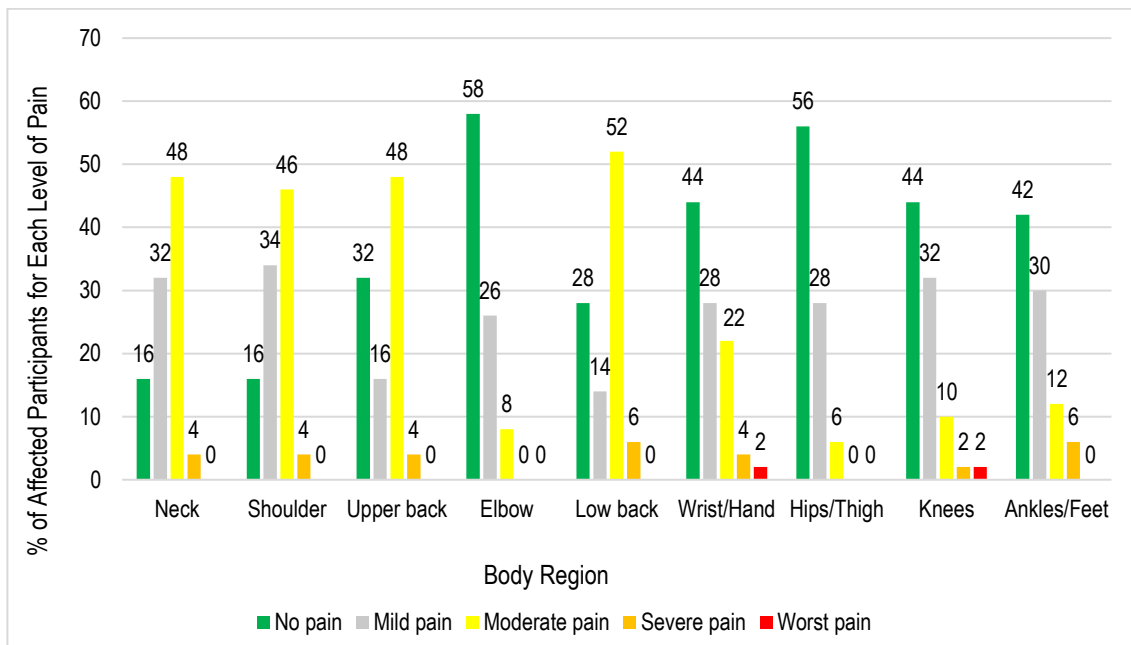| No	Effect of WMSD	Number of Respondent	Percentage (%)
1	Been hospitalized because of the trouble		
	Yes	2	4
	No	48	96
2	Seen a doctor or other such person because of trouble		
	Yes	14	28
	No	36	72
3	Taken sick leave from work		
	Yes	27	54
	No	23	46
4	Had to change duties (even temporarily) because of the trouble		
	Yes	5	10
	No	45	90

Figure 5. Distribution of musculoskeletal discomfort level severity

Association Between Risk Factors and Prevalence Musculoskeletal Discomfort

The data relating to the association between sociodemographic factors and occupational factors and the prevalence of musculoskeletal discomfort during the last 12 months were presented in Tables 5 and Table 6 respectively. The neck complaint was the most prevalent musculoskeletal discomfort. Neck discomfort was statistically significantly associated with the participant's working experience (p = 0.035). There is small correlation strength between neck discomfort and working experience (r = 0.299). Besides, the neck discomfort were statistically significant associated with daily computer use (p = 0.040 ; r = 0.123) and average daily virtual meeting during WFH (p = 0.036 ; r = -0.298). Moretti et al. (2020) found physical health associated with remote working will increase sedentariness and bad posture in our population due to the use of non-ergonomic equipment that appeared to accelerate the emergence of WMSDs, specifically lower back pain, and neck pain. In a study performed by S.-P. Lee et al. (2018), support that more cervical and thoracic extensor activity are required to maintain the head in the forward position when using the computer too long. This may result in distinct stress zones and postural neck discomfort. Another study by Nunes et al., [27], which concerning about the variables of age; between 50 and 65 years, and the number of working hours on a computer without a break, were the most important risk factors for neck discomfort.

Table 5. Association between sociodemographic factors and prevalence of musculoskeletal discomfort for the last 12 months

Sociodemographic factor	Neck discomfort		Shoulder discomfort		Upper back discomfort		Low back discomfort	
	r	p	r	p	r	p	r	p
Gender	-0.158	0.274	- 0.309	0.290	-0.238	0.096	-0.202	0.160
Age (years)	0.154	0.285	-0.108	0.457	0.161	0.265	0.032	0.825
Weight (kg)	0.217	0.131	0.285	0.045 *	0.294	0.038 *	0.138	0.339
Height (cm)	0.186	0.196	0.333	0.018 *	0.398	0.004 *	0.199	0.166

Table 6. Association between occupational factor and prevalence of musculoskeletal discomfort for last 12 months

Occupational factor	Neck discomfort		Shoulder discomfort		Upper back discomfort		Low back discomfort	
	r	p	r	p	r	p	r	p
Working experience (years)	0.299	0.035 *	0.088	0.545	0.419	0.002 *	0.295	0.370
Daily working (hours)	0.069	0.633	-0.158	0.275	-0.189	0.188	-0.024	0.867
Daily computer or laptop use during work (hours)	0.123	0.040 *	-0.250	0.010 *	0.026	0.858	0.045	0.037 *
Daily external keyboard use (hours)	0.143	0.322	-0.175	0.225	0.002	0.991	-0.180	0.212
Use external mouse	0.269	0.059	0.229	0.110	0.190	0.185	0.182	0.205
Average daily virtual meeting during WFH	-0.298	0.036 *	-0.282	0.047 *	-0.302	0.033 *	-0.072	0.619
Breaks sufficient	-0.077	0.593	0.121	0.403	-0.091	0.531	0.069	0.632

Shoulder complaints were the second most prevalent musculoskeletal discomfort. In this study, the socio-demographic factors that are associated with shoulder pain are weight (p = 0.045 ; r = 0.285), height (p = 0.018 ; r = 0.333) and daily computer use (p = 0.010 ; r = -0.250). All the p-values for the three factors are below 0.05, so they are statistically significant. Although several research studies had already explored this relationship, there were some inconsistencies in this domain. For instance, in the studies of Baberi et al., [28], the relationship between BMI and WMSD occurrence was not statistically significant. This study also found that shoulder discomfort was significantly associated with an average daily virtual meeting during WFH (p = 0.047). A previous study by Gerding et al., [29], found discomfort seemed to grow when staff were forced to telework. More than 40% of survey respondents reported moderate to severe pain during teleworking, especially in the eyes, neck, head, upper back/shoulders, and lower back/shoulders.

The upper back was the third most prevalent musculoskeletal discomfort. The prevalence of upper-back discomfort was significantly associated with weight (p = 0.038 ; r = 0.294), height (p = 0.004 ; r = 0.398), working experience (p = 0.002 ; r = 419) and average daily virtual meeting during WFH (p = 0.033 ; -0.302). There is a medium correlation between the upper back and working experience because the r-value is 0.30 – 0.49. A research study conducted by Kibret et al., [30], states that increasing working experience increases the probabilities of WMSDs, and the likely cause raises tiredness and muscular tension for many years.

Low back pain was the fourth most prevalent musculoskeletal discomfort. The prevalence of low back discomfort was statistically significantly associated with daily computer use (p = 0.037; r-value = 0.295), and the correlation is small. According to Tasneem et al., [31], prolonged sitting while using a computer with poor ergonomics is a risk factor for musculoskeletal issues. The issues include back pain due to increased pressure on intervertebral discs, ligaments, and muscle strain. Bontrup et al., [1], defined that participants with chronic lower back pain or associated impairment had a stronger relationship between sitting behavior when using a computer compared to those with acute pain.

The association between the severity of body discomfort and the activity of daily living

Referring to Table 7, the prevalence of neck discomfort (p < 0.001; r = -0.485), shoulder discomfort (p < 0.001; r = -0.566), upper back discomfort (p < 0.001; r =-0.586) and low back discomfort (p = 0.002; r =-0.419) are statistically highly significant because the p-value for neck, shoulder, and upper back is less than 0.001, except for low back, which is below 0.05, which is statistically significant. Working activity has a considerable correlation with strong shoulders and upper back. According to Kibret et al., [30], work-related musculoskeletal problems substantially impact lost work time or absenteeism, increased work restrictions, changing jobs with significant pay, and losses in the individual.

Leisure activity is associated with musculoskeletal discomfort of the shoulder because the p-value is 0.041. Family activity was not statistically significant with neck discomfort (p = 0.528; r = 0.091), shoulder discomfort (p = 0.297; r = -0.151), upper back discomfort (p = -0.190; r = 0.187) and low back discomfort (p = -0.178 ; r = 0.217). Based on Basakci Calik et al., [2], the investigation revealed that musculoskeletal discomfort during computer use harms activity in daily living.

Table 7. Association between pain severity of body discomfort and affected activity daily life

Activity Daily Life	Neck discomfort		Shoulder discomfort		Upper back discomfort		Low back discomfort	
	r	p	r	p	r	p	r	p
Work activity	-0.485	< 0.001 *	-0.566	< 0.001 *	-0.586	< 0.001 *	-0.419	0.002 *
Leisure activity	0.021	0.884	-0.291	0.041 *	-0.246	0.085	-0.273	0.055
Family activity	0.091	0.528	-0.151	0.297	-0.190	0.187	-0.178	0.217

The association between the severity of body discomfort and work aspects

As shown in Table 8, the prevalence of neck discomfort (p <0.001; r = -0.523), shoulder discomfort (p < 0.001; r =-0.566), upper back (p <0.001; r =-0.573) and low back (p = 0.002; r =-0.434) are statistically highly significant because the p-value for neck, shoulder, and upper back is less than 0.001, except for low back, which is below 0.05, which is statistically significant. Jusoh et al., [32], mention that support staff play a significant part in university performance. Their absence from work may lead to low productivity, decreased availability, and performance loss to achieve the university's yearly objective. Job motivation was not statistically significant with musculoskeletal discomfort of the neck (p = 0.884; r = 0.021), shoulder (p = 0.800; r = -0.037), upper back (p = 0.409; r = -0.119) and lower back (p = -0.677 ; r = -0.060).

t is critical to note that the lack of evidence for a causal relationship between a factor and musculoskeletal discomfort does not suggest that the factor is not a risk but requires further study. Finally, risk factors with a specific "strength of proof" are not the only ones to be reviewed; they are simply the ones that have previously been explored.

CONCLUSION

This study's main finding was that the neck, shoulder, upper back, and lower back were the most painful body regions among office workers due to prolonged computer use and prolonged sitting. The sociodemographic risk factors related to musculoskeletal discomfort are age, weight, and height. Moreover, the most significant occupational risk factors are working experience, daily computer use, and virtual meetings during WFH. Work and leisure activities are the most affected by the pain experienced by the respondents. In terms of work aspects, this study determined that job performance is the most significantly affected due to musculoskeletal discomfort.

This study's findings provide some awareness to office workers regarding risk factors related to musculoskeletal discomfort when computer use and prolonged sitting. Besides, it is time for organizations to have corrective measures and correct working practices to reduce ergonomics risk factors and improve workers' productivity. Future studies should include a larger sample and a more extended period to identify musculoskeletal discomfort factors further. There are

opportunities to access the knowledge, behaviour, and practices in safety, health, and ergonomics regarding prolonged computer use in the workplace. Provide prolonged computer use guidelines to reduce musculoskeletal discomfort among office workers.

ACKNOWLEDGMENT

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