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Prevalence rate of neck, shoulder and lower back pain in association with age, body mass index and gender among Malaysian office workers

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Abstract.
BACKGROUND: Malaysian office workers often experience Musculoskeletal Discomfort (MSD) which is typically related to the low back, shoulders, and neck.
OBJECTIVES: The objective of this study was to examine the occurrence of lower back, shoulder, and neck pain among Malaysian office workers.
METHODS: 752 subjects (478 women and 274 men) were randomly selected from the Malaysian office workers population of 10,000 individuals. The participants were aged between 20–50 years and had at least one year of work experience. All participants completed the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Instructions to complete the questinnaire were given to the participants under the researchers supervision in the morning before they started a day of work. The participants were then classified into four categories based on body mas index (BMI) (BMI:$\leq$18.4, 18.5–24.99, 25–29.99, $\geq$30) and age (Age: 20–29, 30–39, 40–49, $\geq$50).
RESULTS: There was a significant association between pain severity in gender and right ($p = 0.046$) and left ($p = 0.041$) sides of the shoulders. There was also a significant association between BMI and severity of pain in the lower back area ($p = 0.047$). It was revealed that total pain score in the shoulders was significantly associated with age ($p = 0.041$).

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CONCLUSIONS: The results of this study demonstrated that a significant correlation existed between pain servity for gender in both right and left shoulder. These findings require further scientific investigation as do the identification of effective preventative stratgies.

Keywords: Physical pain, musculoskeletal discomfort, Cornell questionnaire

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1. Introduction

Musculoskeletal discomfort (MSD) associated with low back, shoulder, and neck pain are a main reason of physical discomfort in the workplace [1, 2]. MSDs are often present in numerous occupations as a result of the physical activities required in the workplace [3, 4]. The expanding development in the field of information technology has resulted in alterations to jobs performed by office workers [5]. As a result, nearly 50% are engaged in work activities that require a significant amount of time using a keyboard and a mouse [6, 7].

The growing occurrence of low back, shoulder, and neck pain has been reported to be associated with alterations in work postures and job duties [8, 9] and it can result in large economic burdens by having a negative effect on the gross domestic product (GDP) [10]. It was identified that office workers in the Netherlands experienced numerous MSDs in the forearms, arms, shoulders, neck, knees, and wrists, in addition to the lower and upper back regions [11]. The symptoms associated with these MSDs often include pain or tingling/numbness and often progress to becoming chronic in nature [4, 12]. The American Bureau of Labor Statistics has subsequently discovered that in the United States of America (U.S.A.) almost two-thirds of new cases of physical discomfort starting at work are directly related to the low back, shoulders, and neck [4, 13].

Malaysia has seen an increase in the number of office workers over the past few years [4, 14]. It has been reported that in Malaysia, MSDs are frequent among office workers [2, 15–17]. Malaysia's National Institute of Occupational Safety and Health (NIOSH) reported that 61% of the jobs require computer use [18, 19]. The presence of MSDs results in considerable lost work productivity and additional sick leave both of which contribute to and increased economic burden on employers [20]. According to the results of a study performed by Shariat et al. in 2016 [4], among office workers in Malaysia, 69.7% of the participants showed a high pain severity score in the lower back, shoulders, and/or neck. However, only 11% indicated at least one high severity score in the upper back, knees, arms, hands, wrists, forearms, thighs, and hips [4].

It has been reported that women tend to experience MSD in the shoulders and neck more than men [14]. This was also demonstrated by Mahmud et al. in 2012 [21] as they found women are more vulnerable (72%) to pain in the upper body and neck regions compared with men (51%). This difference between genders might be related to the difference in anthropometrics between females and males where work stations might be more likely designed for the male sex [22, 23].

For many years, the relationship between body mass index (BMI) and MSD, particularly shoulder pain, neck and low back, has been known [24–26]. However recently, researchers tried to identify this relationship among office workers who are sedentary and work with a computer for 8 hours a day. In another example Pozo-Cruz et al. in 2013 performed a study and found that sedentary office workers with low back pain presented with lower musculoskeletal fitness and higher BMI [27]. Additionally, musculoskeletal symptoms are directly correlated with BMI especially in individuals with low back pain [28]. It is also interesting to note that overweight employees were at a higher risk that individuals with normal weight to develop symptoms and were less likely to fully recover [12]. Therefore, it is essential to examine if BMI is associated with MSD among office workers. If significant correlations exist it might provide clinicians with an opportunity to identify those likely to develop MSDs.

The prevalence of pain associated with MSDs has been shown to increase in individuals aged between 15 and 45 years [29]. However, it is unclear if a correlation exists between various age groups and the severity of pain, especially among office workers.

The novelty of the study is in the population being studied; office workers who work daily at least 8 hours with their computers, are an under-represented group in research trials done in developing countries [30]. Therefore, the purpose of this research was to determine the prevalence of low back, shoulder and neck pain in association with selected risk factors including age, gender, and BMI among office workers in Malaysia.

2. Methods

2.1. Subjects

Office workers in Kuala Lumpur, Malaysia with at least 1 year of work experience in office related jobs requiring computer use between 20 and 50 years of age were invited to participate.

Initially, the volunteers were selected at random in February 2015, from Malaysian office workers employed in four various regions including the north, west, east, and south of the Kuala Lumpur, Malaysia. A list of names (a population of 10,000 Malaysian office workers) was provided by the main office (north of Kuala Lumpur) the randomly selected company and individuals were randomly selected using a random number generator. The research protocol contained a statement of the ethical considerations involved (participants were volunteers and were informed about details of this research project) and indicated that there was compliance with the principles enunciated in Helsinki Declaration [31].

The sample size was calculated according to the estimated number of individuals employed in office jobs in Kuala Lumpur. We estimated the number of office workers to be 10,000 and considered a possible sampling error of 4%. The formula was: $n = \text{N.no/N+no}$ (where; no = the first approximation of the sample size – $1/\text{error}^2$) is taken into consideration by the equation [32]. The estimated sample size included 588 participants, but 28% was added because of the likelihood of refusals or withdrawals, so the total number of subjects required was 752.

After preparing the draft proposal and discussion with independent experts, April and May 2015 were spent finding suitable computer-based companies with similar tasks and environments for the study. This was followed by meetings with managers in Kuala Lumpur to ascertain their interest in participating in their respective locations (June-July). Data collection began in August 2015 and the data collection concluded in November 2015.

2.2. Data collection

Participants were asked prior to the start of a work day for their respective jobs as it was in the morning and we anticipated they would not be tired and had enough mental energy to focus on the questions and could answer accurately. Participants completed all questionnaires and provided demographic information. At the end of the session, the investigator inspected each questionnaire to confirm that all the questions had been completed. The duration of each session was approximately 25 minutes. During data collection researchers were available to answer any questions raised by the subjects.

2.3. Questionnaire

The questionnaire used was the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) which is often used to study MSDs [3]. Numerous questionnaires which focus on posture were used and developed prior to the CMDQ [3, 17]. However, CMDQ differs from other questionnaires since it not only estimates the discomfort according to occurrence and seriousness but also takes into account the extent to which MSD's can influence job performance negatively [3, 17]. Recent research has used three questions in each part of the questionnaire, specifically 1) How often did you encounter discomfort, pain, and/or aches when you were last at work? (frequency score), 2) How uncomfortable were you when you encountered such discomfort, and/or pain, aches? (discomfort/severity score), and 3) If you experienced this discomfort, pain, and/or aches, did you also experience any form of interference in your work? (interference score) Each part of the questionnaire is in turn labeled as Lower Back, Shoulders, Upper Arms, Upper Back, Neck, Forearms, Knees, Hips, Wrists, Thighs, Left Lower Leg, and Right Lower Leg [17].

This questionnaire was then translated to the Bahasa Melayu language with official consent from the questionnaire's owner and the psychometric properties (reliability and validity) were estimated. The questionnaire mixed the Cornell Questionnaire and background information, and was validated initially using face and content validity throughout group discussion and lastly by an orthopedics expert. In a pilot study, the questionnaire's reliability was calculated using 115 security office employees that from the university of Putra Malaysia whose first language was Bahasa Melayu [17]. The ranges of

Kappa coefficients fell in 0.690–0.949 for frequency, 0.801–0.979 for severity and 0.778–0.944 for interference scales, and showed considerable consistency of the items for each sub-scale for the Cronbach Alpha coefficient (Cronbach's $a > 0.95$).

2.4. Data analysis

Frequency and percentage were used with descriptive values and the prevalence of pain was then calculated. A chi-square test for trend ($r \times c$) was applied to examine the association between pain severity and total pain score with demographic variables. Statistical significance was set at 5% and all analyses were performed using SPSS version 21 (IBM SPSS®, Armonk, NY, USA).

3. Results

3.1. Demographics

All subjects who agreed to participate were Malaysian citizens aged from 20 to 50 (29.28 (SD = 6.14)) years (Table 1). Within this population, the majority were women, 65.1% of the total sample ($n = 752$). There was no attrition during this study. All individuals had at least one year of experience in their current jobs which included doing similar tasks to what they were currently performing. The participants were classified into 4 groups according to their age, 20–29, 30–39, 40–49, and ≥50 years. There weren't any out-of-range cases in the stage of data screening and there was only 2% missing data. The missing values detected were not taken into consideration by the researchers in this analysis.

3.2. Prevalence of pain based on the total score

The findings of this study demonstrated that more than 50% of subjects reported pain in their neck, shoulders or lower back, and the highest report was related to low back (60.6%). It should be mentioned that 8.2% of subjects had severe pain in the neck and low back (Table 2).

3.3. Association between severity of pain and age, sex and BMI

According to the questionnaire's results, low back, shoulder, and neck pain severity based on age, gender, and BMI are presented in Table 3. The findings showed a significant association between pain severity in gender and right ($\chi^2 = 6.174$, $p = 0.046$) and left ($\chi^2 = 6.373$, $p = 0.041$) sides of the shoulders and the severity of pain was higher among male subjects for both sides. There was also a significant association between BMI and severity of pain in the low back ($\chi^2 = 5.788$, $p = 0.047$), however, there was no significant association between age and severity of pain. In addition, there was no significant relationship between gender, age, BMI, and severity of pain in the neck ($p > 0.05$).

3.4. Associationbetween total pain score and age, sex and BMI

According to the questionnaire's instructions [3], total score in the low back, shoulder, and neck were categorized and calculated into four levels (1 = no pain, 2 = pain, 3 = serious pain, 4 = danger). The associations between overall pain and gender, age, and BMI are presented in Table 4. The results revealed that total pain score in the shoulders were significantly associated with age ($\chi^2 = 17.524$, $p = 0.041$) which indicated that respondents with higher age reported higher score of pain. In addition, there was a significant association between total pain score in the low back and BMI ($\chi^2 = 10.375$, $p = 0.036$), however, there was no significant association between gender and total pain score. Also, there was no significant relationship between gender, age, BMI, and total pain score in the neck ($p > 0.05$).

Table 1
Descriptive statistics of the subjects at baseline (N = 752)

Variable	Men ($n = 274$)	Women ($n = 478$)	p
	Mean ± SD	Mean ± SD	
Age (year)	28.8 ± 6.24	29.54 ± 6.1	0.129
Height (cm)	161.9 ± 9.9	162.2 ± 9.9	0.78
Weight (kg)	70.8 ± 20.4	68.9 ± 20.2	0.203
BMI (kg/m^2)	26.8 ± 6.7	26.1 ± 6.4	0.109
Working duration (h)	8.21 ± 0.41	8.16 ± 0.36	0.631

Notes. cm: centimetres; kg: kilograms; h: hour; BMI: body mass index.

Table 2
Prevalence of pain based on the total score (N = 752)

	Neck (%)	Right Shoulder (%)	Left Shoulder (%)	Lower back (%)
1	20.6	19.4	19	17
2	55.8	58.6	55	60.6
3	15.4	16.7	18.3	14.2
4	8.2	5.3	7.7	8.2

Notes. 1 = no pain, 2 = pain, 3 = serious pain and 4 = danger.

4. Discussion

The purpose of the current study was to examine the prevalence of low back, shoulder and neck pain in association with selected risk factors including age, gender, and BMI among office workers in Malaysia. We used the Cornell Questionnaire to evaluate the prevalence of MSD's in a sample of 752 individuals employed as office workers requiring computer use in Malaysia at this allows investigators the opportunity to examine both the total pain score and the severity of pain in a single anatomical location. The current study focused on the neck, shoulders and back similar to a study [4] performed on a similar population on Malaysian office workers. Previous studies have typically been based on the total pain scores (total scores for frequency score, discomfort score, and interference score) which makes it difficult to compare our current findings with those [33, 34].

The results of the current study found there is a higher prevalence of MSD in the shoulders, neck and back in comparison to other anatomical locations. It is possible that the reason for this could be directly related poor posture or other physical factors [35, 33]. Abnormal postures may result in muscle fatigue and recruitment of more muscle fibers over time as a compensatory methods potentially leading to injury to muscle resulting in pain.

The current study identified significant associations between the severity of pain in the shoulder and sex with males reporting a greater severity of pain. These findings are similar to two other studies which identified that females are more likely to develop MSDs in comparison to men of a similar age [36]. Additionally, neck and shoulder pain are more prevalent in females than males [36]. It is possible that the identified association between the shoulder and severity of pain could be potentially related to the frequent physical use of these anatomical regions with work activities in comparison to use of the neck or low back [34, 37].

Our results also identified a significant association between the severity of low back pain and BMI. In addition a significant association was reported between total pain scores in the low back and BMI. BMI is correlated with the magnitude of symptoms particularly in the region of the low back. Additionally, the association differed between individuals who had either a high or low physical workload [38].

Table 3
Severity of neck, shoulders, and lower back pain based on age, gender, and BMI (N = 752)

	Neck (n)			Right Shoulder (n)			Left Shoulder (n)			Lower Back (n)		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Age												
20–29	71	243	155	91	209	169	96	208	165	85	246	138
30–39	36	117	76	46	110	73	46	110	73	49	109	71
40–49	6	23	19	8	22	18	9	22	17	8	24	16
≥50	0	2	5	3	1	3	3	1	3	3	3	1
χ^2		5.674			5.080			4.428			4.739	
P		0.461			0.534			0.619			0.578	
Gender												
Male	98	81	96	107	87	81	82	93	100	98	86	91
Female	170	156	152	156	179	143	170	152	156	169	147	162
χ^2		4.897			6.174			6.373			0.491	
p		0.086			0.046*			0.041*			0.782	
BMI												
≤18.4	25	87	62	29	86	59	32	83	59	39	85	50
18.5–24.99	44	158	91	57	145	91	57	146	90	58	155	80
25–29.99	32	92	62	38	76	72	38	78	70	33	94	59
≥30	12	48	39	24	35	40	27	34	38	14	48	37
χ^2		3.674			9.572			9.577			5.788	
p		0.721			0.144			0.144			0.047*	

Notes. ≤18.4 = Underweight, 18.5–24.99 = normal range, 25–29.99 = over weight, ≥30 = Obese (danger).

Table 4
Total pain score in neck, shoulders, and lower back based on age, gender, and BMI (N = 752)

	Neck (n)				Right Shoulder (n)				Left Shoulder (n)				Lower Back (n)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Age																
20–29	95	259	78	37	90	270	75	34	92	246	90	41	81	275	65	48
30–39	55	124	28	22	51	136	38	4	38	137	42	12	37	150	31	11
40–49	5	33	7	3	5	31	10	2	11	29	4	4	8	26	11	3
≥50	0	4	3	0	0	4	3	0	2	2	2	1	2	5	0	0
χ^2	13.575				17.524				14.273				12.369			
P	0.138				0.041*				0.029*				0.193			
Gender																
Male	56	144	49	26	52	166	42	15	50	158	51	16	45	170	38	22
Female	99	276	67	36	94	275	84	25	93	256	87	42	83	286	69	40
χ^2	3.337				0.859				2.640				0.292			
P	0.343				0.835				0.451				0.962			
BMI																
≤18.4	34	108	22	10	33	102	28	11	33	95	34	12	31	113	15	15
18.5–24.99	54	170	38	31	52	174	52	15	51	172	47	23	52	176	43	22
25–29.99	47	92	33	14	43	105	28	10	46	91	31	18	32	107	34	13
≥30	20	50	22	7	18	60	17	4	13	55	26	5	13	59	15	12
χ^2	15.264				3.276				14.037				10.375			
p	0.084				0.952				0.121				0.036*			

Notes. 1 = no pain, 2 = pain, 3 = serious pain and 4 = danger; ≤18.4 = Underweight, 18.5–24.99 = normal range, 25≤X≤29.99 = over weight, ≥30 = Obese (danger). 1 = no pain, 2 = pain, 3 = serious pain and 4 = danger.

Employees who were obese exhibited a higher risk for developing symptoms while also being less likely to have a resolution of those symptoms than normal weight employees. A high amount of adipose tissue around the muscles and joints can limit a person's movements, thereby stressing musculoskeletal tissues potentially resulting in pain [39, 40]. In fact one study found that obese individuals have significantly less shoulder range of motion that individuals with normal weight [40]. Perhaps this is why ergonomic intervention recommendations have been made in an attempt to enhance work capacity [41]. These findings are in report of a recent study demonstrating a significant relationship between BMI and musculoskeletal pain, especially in the low back. The authors concluded that obese individuals may especially benefit from physical exercise interventions targeting musculoskeletal pain and preventing MSDs [42].

The findings of the current study support the findings of a recent study that also found a strong relation between total pain score and age among Estonian computer users [43]. Most people experience shoulder, neck, and low back pain between the ages of 20 and 40 years for the first time and this type of pain reappears in a considerable percentage of people [44]. Furthermore, in 2013, Pozo-Cruz et al. demonstrated a meaningful association between musculoskeletal pain, especially in the low back and shoulder area and age among one-hundred and ninety sedentary office workers and their findings are similar to ours as they showed that office workers with a higher age, had greater pain levels in comparison with younger individuals [27]. Kaliniene et al. (2016) reported that the prevalence rates of shoulder, elbow, wrist/hand, upper and low back pain among computer workers of the public sector in Kaunas County, Lithuania were 50.5%, 20.3%, 26.3%, 44.8%, and 56.1%, respectively [45]. In their study, individual factors such as gender, age, computer work experience, and body mass index were found as significant for musculoskeletal pain in various musculoskeletal regions. The duration of working with a computer was found as a significant factor for shoulder pain. High quantitative demands were related to musculoskeletal pain in all investigated anatomical areas expect for the low back; weak social support was a significant predictor for complaints in upper and low back areas. They also confirmed associations between musculoskeletal pain and work ergonomics; therefore, preventive measures at the workplace should be directed to the improvement in ergonomic work environment, education, and workload optimization [45].

The current study showed if we consider shoulder and low back pain, based on severity of pain, it would be in association with BMI and gender. However, if we look at neck, shoulder and low back pain based on the total pain score there is an association between

BMI and age. For the calculation of total pain scores, not only severity, but also frequency and interference of pain should be considered. If we consider all these parameters, age may have an association with pain rather than gender. Occupational hazards may be due to a high prevalence of not having awareness of safety measures, poor ergonomic stations in the working environment [13]. Performing a task without considering ergonomic demands imposes different types of stress, which may have a harmful influence on the human physiology and anatomy [21, 40].

A significant association was reported between total pain scores in the low back and BMI. Numerous studies have investigated individual risk factors including BMI and their relationship to musculoskeletal pain. A BMI of >25 kg/m^2 was found to be associated with MSD in the low back which is in agreement with other epidemiological studies [46, 47]. Alshagga et al. (2013) found a the prevalence of musculoskeletal pain (MSP) among medical students was significantly associated with the academic year, history of trauma, family history of MSP and BMI [48]. In addition, some epidemiological studies have reported that middle-aged employees are most vulnerable to pain in neck and shoulder [49, 50]. Other researches confirm working environment is not the only factor that has an impact on the development of musculoskeletal disorders individual characteristics such as gender, age, and BMI are also contributors [46, 51].

Future research should investigate practical and cost effective treatments for office workers to prevent or reduce the prevalence of MSDs. This could potentially be beneficial not only for the health of office workers but also the economic outcome of companies by decreasing the amount of sick leave [10]. This study should be considered in context with several limitations: a) the results only apply to office workers in Malaysia, b) because of time and financial restrictions the collected data are only from KL, the capital of Malaysia, not the whole country, and c) there is absence of assessment related to how the pain impacted work duties of this population.

5. Conclusion

The current study identified some important relationships that may contribute to the development of MSDs. We found a significant association with low back, shoulder, and neck pain with age, gender and BMI in a population of Malaysian office workers. Now that relationships have been identified it is important for researchers to begin examining potential interventions studies in individuals with these characteristics that can prevent the occurrence of MSDs in office workers.

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Conflict of interest

The authors did not have any conflicts of interest.

Ethical approval

The Department of Occupational Health at the University Putra Malaysia provided ethical approval required for the study.

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