ORIGINAL ARTICLE

Prevalence of Musculoskeletal Disorders and Associated Ergonomic Risks Among Pahang School Teachers

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ABSTRACT

Introduction: Musculoskeletal disorders (MSDs) are common health issues affecting teachers. This study aims to determine the relationship between ergonomic risk factors and the prevalence of MSDs among teachers in both public and international schools in Pahang. **Materials and Methods:** This cross-sectional study involved 177 teachers from Pahang's public and international schools. Data collection involved the use of the Quick Exposure Check (QEC) to assess ergonomic risk factors, a comprehensive work environment analysis incorporating the QEC, and the administration of the Nordic Musculoskeletal Questionnaire (NMQ) to determine the prevalence of MSDs. **Results:** This study found a significant differences in ergonomic risk factors such as lifting heavy loads (x^2=67.40, p=<0.001), awkward postures (x^2=49.01, p=<0.001), prolonged standing x^2=83.14, p=<0.001), and prolonged sitting (x^2=77.28 p=<0.001) between the two school types. The MSD prevalence shows significant differences between two public and international schools with the pain on shoulders (x^2=34.93, p=<0.001), neck (x^2=9.55, p=0.002), lumbar(x^2=24.13, p=<0.001), thoracic (x^2=9.22, p=0.002), and hips/thighs (x^2=35.81, p=<0.001). Logistic regression analysis indicated that lifting heavy loads was associated with lower back pain (OR=2.57, 95% CI=1.168-5.636), while prolonged sitting was linked to shoulder (OR=11.93, 95% CI=2.488-57.166), lower back (OR=2.53, 95% CI=1.063-6.009), and hip/thigh pain (OR=2.232, 95% CI=1.033-4.819). Prolonged sitting emerged as the strongest predictor of MSDs, with teachers reporting frequent prolonged sitting being 11 times more likely to experience shoulder pain. **Conclusion:** Encouraging proper posture is crucial in preventing work-related injuries. To effectively reduce the incidence of MSDs, it's essential to establish and maintain a comprehensive ergonomics education and training program.
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Keywords: Ergonomic risk factor, Musculoskeletal Disorders (MSDs), School Teachers, Quick Exposure Check (QEC), Nordic Musculoskeletal Questionnaire (NMQ).

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INTRODUCTION

Teachers represent a substantial demographic within both the public and private sectors in Malaysia. In the government sector, teachers are employed primarily in public schools and institutions, forming a major part of the civil service workforce. In the private sector, teachers work in private schools, international schools, and other educational organizations. They contribute significantly to the nation's education system, which is a key driver of social and economic development. Consequently, their well-being and effectiveness are crucial to the nation's public education system (1). Beyond fostering student excellence, high-performing teachers significantly enhance the overall quality of education among Malaysian schoolchildren. To elevate

educational standards, the Malaysian government has prioritized policy development aligned with the Education Development Master Plan and the Malaysia Education Blueprint 2013 to 2015 (2). Both frameworks emphasize the pivotal role of teachers in cultivating human capital for the nation's economic prosperity and overall development. However, the convergence of technological advancements, societal shifts, and sustainability demands has transformed the educational landscape. Teachers now juggle increased administrative responsibilities, complicating their roles (3). Consequently, teachers face heightened exposure to a range of occupational hazards. Prolonged sitting or standing while teaching can lead to musculoskeletal issues like back pain, neck pain, and carpal tunnel syndrome (1, 3). High stress levels stemming from classroom management challenges, student behavior issues, and demanding workloads can significantly impact teacher's mental and physical health. Additionally, Work-related musculoskeletal disorders (MSDs) among school teachers are linked to factors such as frequently adopting "head-down" postures, improper use of kinetic handling techniques, repetitive strain from lifting and holding tasks, poor posture caused by unsuitable furniture, lack of proper back support, and extended periods of static or twisting postures (4).

Musculoskeletal disorders (MSDs) are prevalent among teachers, ranking them as a high-risk occupational group even in developed countries (4) ranging from 39 to 95% (5). Research indicates that teachers regularly encounter ergonomic risk factors on the job (3). The physical demands of teaching, such as prolonged standing, sitting, and repetitive overhead writing, frequently lead to musculoskeletal complaints, particularly in the lower back, neck, and shoulders (6). These disorders impose a significant burden on educational institutions, resulting in substantial financial losses due to increased sick leave, decreased productivity, retraining costs, legal expenses, and injury benefits. This not only affects teachers' well-being but also has a detrimental impact on the overall efficiency and sustainability of schools (7). Data from the Ministry of Education (MOE) indicates that 4360 teachers opted for early retirement in 2021. The Deputy Minister highlighted that health concerns, including MSDs, were the reason behind 411 of these decisions (8).

MSDs occur when the body's musculoskeletal system is subjected to chronic strain, often due to repetitive movements or awkward postures (9). Teachers, in particular, are at risk of developing MSDs due to the physically demanding nature of their work, which can lead to conditions such as low back pain, epicondylitis, sciatica, carpal tunnel syndrome, or rotator cuff injuries (10). The symptoms of MSD can vary widely in severity and duration (11). While some individuals may experience mild, numbness, tingling, and restricted joint mobility (12). The alarming prevalence of MSD among teachers highlights the urgent need for targeted interventions to mitigate the negative impact of these disorders on the teaching profession.

This research aims to compare the prevalence of MSDs among teachers in public and international schools in Malaysia. Comparing MSDs prevalence can highlight potential areas for improvement in occupational health and safety practices in both public and international schools which can be used to advocate for better working conditions, ergonomic interventions, and occupational health programs for teachers in both sectors. By examining ergonomic risk factors contributing to MSD incidence, this study seeks to develop recommendations for prevention and treatment strategies. Most studies on MSDs among teachers likely focus on specific school types or general populations. Ultimately, this research will expand the current knowledge base on MSDs within the Malaysian teaching population by comparing two distinct settings with potentially different working conditions, resources, and teaching methodologies. The findings will be valuable for public health practitioners, educators, and policymakers in developing targeted prevention programs and improving workplace conditions. Furthermore, the data can inform future research on the ergonomic impact on teachers in Malaysia.

MATERIALS AND METHODS

Study design and participant selection

This cross-comparative study was conducted in Kuantan, Pahang as this town has the highest number of public and international for primary and secondary school from November to December 2022 and is the most populated district in Pahang. To avoid bias in respondent selection, participants were chosen based on specific inclusion and exclusion criteria. This approach ensures that all teachers have a similar lifestyle and exposure. To be eligible, respondents had to be aged 20 to 60 years old, had to have a minimum of 1 year experience of working, and were female. The World Health Organization provides a comprehensive resource through the Ageing Data Portal, which highlights that individuals aged 60 and above are classified as chronological age who often experience a high prevalence of low back pain (12). The prevalence of low back pain was assessed using two common timeframes: point prevalence (the proportion of individuals experiencing low back pain at a specific point in time) and 1-year prevalence (the proportion experiencing it at any time during the past year) (13). This condition is linked to various factors such as levels of functional disability, challenges in performing activities of daily living, functional difficulties, and reduced physical capacity.

Meanwhile, the exclusion criteria include respondents with a history of musculoskeletal disorders, pregnant or menopausal teachers, individuals with obesity, those

who have experienced an accident, are undergoing medication or treatment, or are on their menstrual period during the sampling time. Respondents were selected using simple random sampling, with the list of names obtained from the school administrative office. Additionally, study bias will be further controlled through statistical analysis to account for and minimize any factors that might influence the research outcomes.

Sample size determination

Seven schools, for each public and international schools, were selected using a simple random sampling method from a list provided by the District Education Office in Kuantan. The proportion of respondents needed was sampled using a simple random sampling technique from each of the sampling frames. The sample size was calculated using the comparative study formula adopted by Sharma et al., (2020) (14). The values for $P1$ and $P2$ in this study were derived from a previous research on the prevalence of occupational back pain among Jordanian school teachers (15). The margin of error is 0.05 with 95% confidence interval and considering 20% non-response rate and eligibility.

$$n = \frac{Z^2_{1-\frac{\alpha}{2}}\,[P_1(1-P_1)+P_2(1-P_2)]}{d^2}$$

n = Sample size for one group.
P_1 and P_2 = Proportion of two groups.
d_2 = Desired precision (0.05).
$Z_{(1-\alpha/2)}$ = Critical value and a standard value for the corresponding level of confidence (1.96).

The calculated sample size using the formula was 62.5. After accounting for non-response and eligibility, the final sample size for each study group was set at 75. A total of 343 teachers from both public and international schools were approached, with 304 completing the survey, resulting in an 88.6% response rate. Following screening based on inclusion and exclusion criteria, the final sample size was 177, which exceeded the initially estimated sample size.

Sampling procedure and study instrument

The data for this study was collected from October 2022 until November 2022. Self-administrated questionnaires and task observation were used to collect the data. Questionnaire forms were distributed to participants who volunteered and agreed to answer all questions. Task observation has been made within one day. Data was collected using a self-administered bilingual questionnaire and ergonomic assessment tools; Nordic Musculoskeletal Questionnaire (NMQ) and Quick Exposure Check (QEC). The NMQ was adopted by the Nordic Council of Ministers Crawford (2007), while the QEC was adopted by David et al., (2008) (16). The NMQ is a widely utilized tool for assessing the impact of musculoskeletal pain on an individual's daily life which consists of five sections: socio-demographic, health factors, occupational characteristics, occupational factors, and signs and symptoms. On the other hand, the Quick Exposure Check (QEC) tool was used to assess the risk of musculoskeletal disorders among teachers. The evaluation focuses on the four primary body regions which identified elements (load, posture, frequency of movement, visual demands, and vibration) and the score will be interpreted based on Table I. The QEC evaluation began by assessing teachers' postures and administering questionnaires on the exposure level at their body parts; back, shoulder/arm, wrist/hand, and neck. Teachers rated each item on a categorical scale, and a total score was calculated for each body part. These scores were then categorized into four exposure levels: low, moderate, high, and very high.

Table I: Score interpretation for each item of the Quick Exposure Check (QEC)

QEC items	Exposure level score			
	Low	Moderate	High	Very High
Back static	8 - 15	16 - 22	23 - 29	29 - 40
Back motion	10 – 20	21 - 30	31 - 40	41 - 56
Shoulder / arm position	10 – 20	21 - 30	31 - 40	41 - 56
Wrist / hand position	10 – 20	21 - 30	31 - 40	41 - 56
Neck twisted or bent	4 - 6	8 - 10	12 - 14	16 - 18

This study conducted a detailed analysis using a questionnaire and an observation checklist to assess the work environment. It covered teacher education and training, workstations, job procedures, physical conditions, and administrative controls. The evaluation aimed to determine the environment's conduciveness, ergonomic workstation design, and overall safety, focusing on promoting teacher well-being and reducing exposure to hazards.

Data analysis

IBM SPSS software version 28.0 was used to analyse the data. Since categorical data does not produce a distribution, it is not suitable for normality tests. The descriptive statistics of the data were computed including the frequencies, and percentages alongside the range of the data. A chi-square test was used to compare the prevalence of ergonomic risk factors and musculoskeletal disorders (MSDs) between public and international school teachers. Logistic regression analysis for enter method was then conducted to investigate the association between specific ergonomic risk factors and the development of MSDs. A two-tailed significant level of $p<0.05$ was set to determine the significance of the association.

Ethical clearance

The study was approved by the Research Ethical Committee Universiti Teknologi MARA (Reference no.: FERC/FSK/MR/2022/0318). Approval from individual schools, as well as oral and written consents were obtained from individual eligible respondents before data collection.

RESULTS

Socio-demographic Characteristics and Physical Exercise

The background characteristics of the respondents are presented as frequencies (n) and percentages (%). The respondents are dominated by mid-career teachers aged 36 to 50 years old (54.2%), with 87.6% having a Degree in education level followed by a normal body mass index (BMI) of 72.9%, married (81.4%) with no children (78.5%) and stating in 1 level of terrace or bungalow (52.0%). The socio-demographic characteristics among teachers in Pahang have been presented in Table II.

The study found that a significant proportion of teachers, 84.7% do not engage in regular physical activity. Among the remaining 15.3% who reported physical activity, 10.7% participated in light exercise which are activities that do not result in perspiration or shortness of breath. Moderate exercise, characterized by activities that increase breathing difficulty but still allow for speech, was reported by 4.5% (Table II). Regarding the frequency of physical activity, the majority of respondents (10.2%) who exercised did so for 1 to 2 hours per week, while 5.1% exercised for 3 to 4 hours per week. This distinction is important for understanding the intensity and potential health benefits of the physical activity undertaken by the teachers in this study.

Table II: Socio-demographic and physical characteristics among teachers in Pahang

Variables	Frequency (n)	Percentage (%)
Age		
Early Career (20-35)	63	35.6
Mid-Career (36-50)	96	54.2
Late Career (51-60)	18	10.2
Body Mass Index (BMI)		
Underweight	7	4.0
Normal	129	72.9
Overweight	41	23.2
Marital Status		
Single	33	18.6
Married	144	81.4
Number of children		
Not have children	139	78.5
1-2 children	22	12.4
More than 2 children	16	9.0
Smoker		
Yes	0	0
No	177	100
Education level		
Diploma	17	9.6
Degree	155	87.6
Master	2	1.1
PHD	3	1.7
Physical exercise		
Yes	27	15.3
No	150	84.7
Type of physical exercise		
*Light	19	10.7
*Moderate	8	4.5
Hours of physical exercise		
1-2	18	10.2
3-4	9	5.1

**Light exercise (activities that do not result in perspiration or dyspnea), Moderate exercise (activities that increase breathing difficulty but still permit speech)*

Ergonomic risk factors

The findings in Table III suggest that public school teachers in Malaysia are more likely to be exposed to a higher prevalence of ergonomic risk factors compared to their international school counterparts. Prolonged sitting (83.5%), lifting heavy loads (78.8%), and prolonged standing (81.8%) were identified as the most significant contributors to MSDs among public school teachers. While lifting and awkward postures were also concerns for international school teachers, the overall prevalence of these risks was lower compared to public school teachers.

Table III: Comparison of ergonomic risk factors between public and international school teachers in Pahang.

Factors	Frequency (%)		x^2	p-value
	Public	International		
Lift heavy load				
Yes	78 (78.8)	21 (21.2)	67.4	<0.001*
No	13 (16.7)	65 (83.3)		
Frequency of lifting heavy load				
1-2	26 (74.3)	9 (25.7)	69.92	<0.001*
3-4	40 (76.9)	12 (23.1)		
More than 5	12 (100)	0		
Awkward posture				
Yes	68 (78.2)	19 (21.8)	49.01	<0.001*
No	23 (25.6)	67 (74.4)		
How often awkward posture				
1-2	38 (76.0)	12 (24.0)	52.10	<0.001*
3-4	17 (70.8)	7 (29.2)		
More than 5	13 (100)	0		
Prolonged standing				
Yes	81 (81.8)	18 (18.2)	83.14	<0.001*
No	10 (12.8)	68 (87.2)		
How often prolonged standing				
1-2	15 (45.5)	18 (54.5)	109.35	<0.001*
3-4	36 (100)	0		
More than 5	30 (100)	0		
How long prolonged standing				
1-2 hours	11 (37.9)	18 (62.1)	114.77	<0.001*
3-4 hours	70 (100)	0		
Prolonged sitting				
Yes	76 (83.5)	15 (16.5)	77.28	<0.001*
No	15 (17.4)	71 (82.6)		
How often prolonged sitting				
1-2	11 (50.0)	11 (50.0)	91.46	<0.001*
3-4	27 (87.1)	4 (12.9)		
More than 5	38 (100)	0		
Type of seat in office				
Normal chair	91 (100)	0	177.00	<0.001*
Ergonomic chair	0	86 (100)		
Type of seat in classroom				
Normal chair	91 (81.3)	21 (18.8)	108.70	<0.001*
Ergonomic chair	0	65 (100)		
Comfortable using work desk				
Yes	55 (39.0)	86 (61.8)	42.71	<0.001*
No	36 (100)	0		

Chi-square test

*Significant at p<0.05

A significant difference in the frequency of lifting heavy loads was observed between public and international school teachers (p<0.001) indicating that public school

teachers are more likely (3.72 times) to report lifting heavy loads as an ergonomic risk factor compared to their international school counterparts. Awkward posture was significantly more prevalent among public school teachers than among international school teachers (p<0.001). While most teachers reported experiencing awkward postures 1 to 2 times per day, 13 public school teachers indicated having awkward postures more than five times daily. Prolonged standing was the third ergonomic risk factor identified in this study. A significant difference in prolonged standing was observed between public and international school teachers (p<0.001). Female teachers in Pahang, particularly those in public schools, were more likely to stand for prolonged periods, often three to four hours per day. Additionally, teachers in both sectors reported standing for three to four hours approximately three to four times per day. Prolonged sitting was the final ergonomic risk factor examined. Chi-square analysis revealed a significant difference in prolonged sitting between public and international school teachers. A significantly higher percentage of public school teachers (83.5%) compared to international school teachers (16.5%) reported sitting for more than five hours per day.

The prevalence of MSD

The prevalence of MSD in any body region among teachers was rated between 42.9 to 82.5%. The most affected body regions were the shoulders (82.5%), neck (72.3%), lower back (71.8%), upper back (70.1%), wrist or hands (63.8%) and hips (59.9%). Other body regions had lower prevalence rates, below 50% (Figure 1). Table IV demonstrated that public school teachers exhibited a higher prevalence of MSDs across all nine body regions compared to their counterparts in international schools. Chi-square analysis revealed statistically significant differences in MSD prevalence specifically in the neck, shoulder, upper back, lower back, and hips/thighs). Public school teachers were most likely to experience MSDs in the shoulders (x^2=34.93, p≤0.001), neck (x^2 =9.55, p=0.002), lower back (x^2 =24.13, p≤0.001), and hip/thighs (x^2 =35.81, p<0.001). However, no significant differences were observed for other body regions.

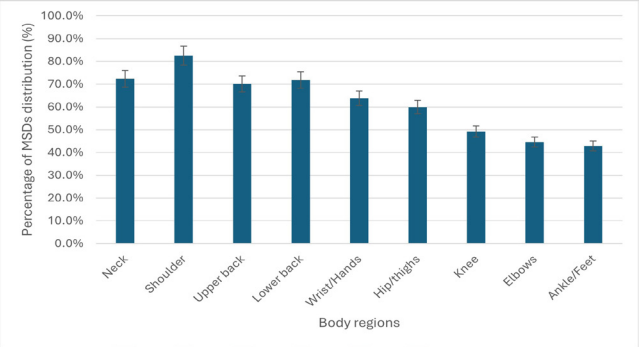

Fig. 1: The percentage distribution of MSDs according to body regions.

Table IV: Comparison of the MSD between public and international school teachers based on body regions.

Body region	Prevalence (%)		x^2	p-value
	Public	International		
Neck	75 (58.6)	53 (41.4)	9.55	**0.002***
Shoulder	90 (61.6)	56 (38.4)	34.93	**<0.001***
Upper back	73 (58.9)	51 (41.1)	9.22	**0.002***
Lower back	80 (63.0)	47 (37.0)	24.13	**<0.001***
Wrists/hands	57 (50.4)	56 (49.6)	0.12	0.732
Hips/thighs	74 (69.8)	32 (30.2)	35.81	**<0.001***
Knees	52 (59.8)	35 (40.2)	4.78	0.29
Elbows	43 (54.4)	36 (45.6)	0.52	0.471
Ankle/feet	45 (59.2)	31 (40.8)	3.24	0.72

Chi-square test
**Significant at p<0.05*

Relationship between ergonomic risk factors and MSDs

Table V presents the results of a logistic regression analysis investigating the relationship between ergonomic risk factors (lifting heavy loads, awkward posture, prolonged standing, prolonged sitting) and the occurrence of MSDs in specific body regions (lumbar back, shoulder, and hips/thighs) among teachers. The results indicate that prolonged sitting was consistently associated with an increased risk of MSDs across all three body regions (i) lumbar back (OR=2.53, p=0.036), (ii) shoulder pain (OR=11.93, p=0.002), and (iii) hips/thighs (OR=2.23, p=0.041). Notably, lifting heavy loads was a significant risk factor for lumbar back pain (OR=2.57, p=0.019), while awkward posture and prolonged standing did not show significant associations with MSDs in any of the examined regions.

DISCUSSION

Most studies on MSDs among teachers will likely focus on specific school types, such as public schools or general populations (17). This research contributed by comparing two distinct settings with potentially different working conditions, resources, and teaching methodologies. The result of the data analysis showed that physical activity among teachers in Pahang reported no regular engagement (84.7%). Fitness plays a crucial role in mediating the relationship between physical activity and cognitive function (18). Several findings show that teachers involved in practical courses reported poorer perceived physical health and higher rates of absenteeism (19). Physical activity may enhance attentional processing by improving the ability to suppress irrelevant neural activity, leading to fostering reaction times in tasks with low perceptual demands (20).

A significant proportion of female teachers (55.9%) faced an elevated risk of developing MSDs due to occupational factors, primarily lifting heavy loads, prolonged sitting, prolonged standing, and awkward postures. These occupational factors were identified as significant ergonomic risk factors among school teachers

Table V: The relationship between ergonomic risk factors and MSDs among teachers

Variables	Teachers					
	χ^2	R^2	B	SE	*p*-value	OR (95% CI)
Lumbar Back						
Constant	24.048	0.183	-1.994	0.348	**<0.001***	
Lifting Heavy loads			0.942	0.401	**0.019***	2.566 (1.168-5.636)
Awkward Posture			-0.320	0.416	0.441	0.726 (0.321-1.640)
Prolonged Standing			0.454	0.430	0.291	1.574 (0.678-3.654)
Prolonged Sitting			0.927	0.442	**0.036***	2.527 (1.063-6.009)
Shoulder pain						
Constant	42.239	0.351	-4.324	0.805	**<0.001***	
Lifting Heavy loads			0.867	0.510	0.089	2.380 (0.877-6.462)
Awkward Posture			-0.163	0.512	0.750	0.849 (0.311-2.316)
Prolonged Standing			0.913	0.545	0.094	2.492 (0.856-7.255)
Prolonged Sitting			2.479	0.800	**0.002***	11.925 (2.488-57.166)
Hips/thighs pain						
Constant	19.075	0.138	-1.219	0280	**<0.001***	
Lifting Heavy loads			0.246	0.367	0.504	1.278 (0.622-2.625)
Awkward Posture			-0.018	0.374	0.962	0.983 (0.472-2.043)
Prolonged Standing			0.643	0.395	0.104	1.901 (0.877-4.123)
Prolonged Sitting			0.803	0.393	**0.041***	2.232 (1.033-4.819)

Logistic Regression, (Model Enter Method)
B = Unstandardized coefficient; SE = Standard Error, R^2= Nagelkerke R^2
**Significant at p < 0.05*
**Significant OR* > 1, 95% CI*

in China, potentially contributing to the development of MSDs in the lower extremities (21). MSDs refer to conditions characterized by pain, discomfort, joint pain, swelling, and tingling in specific body areas, including the neck, shoulders, back, elbows, arms, hands, hips, and feet, resulting from work-related factors (22). A comparison with the findings of Ebied., (23), revealed similarities in the identified ergonomic risk factors among school teachers. Including awkward posture, prolonged standing, and lifting heavy loads. However, the prevalence of these risk factors was significantly higher in the present study compared to Ebied's study, where the prevalence rates were 29.0%, 51.5%, and 21.0% for awkward posture, prolonged standing, and lifting heavy loads, respectively.

In contrast, the rates of prolonged standing reported by Damayanti et al., (24) and Farahwahida et al., (25) were higher than those in this study, at 59.72% and 92.5%, respectively. In developing countries, teachers often face a demanding workload and challenging working conditions. These conditions may include limited resources, inadequate infrastructure, and a lack of support systems, which can significantly impact their overall well-being and job satisfaction (26). In this study, we found a significant difference in the frequency of lifting heavy loads between public and international school teachers (p<0.001). The differences might be due to classroom resources and infrastructure whereas public schools might have older buildings with less modern equipment and resources. This could lead to more manual labor for teachers, such as moving heavy furniture, carrying supplies, or setting up equipment (27). Female teachers, in particular, reported lifting heavy loads three to four times per day. Teachers who reported MSDs most frequently were those who lifted heavy loads, including textbooks, student papers, and classroom equipment, especially physical education teachers (28).

School teachers often engage in tasks that involve repetitive movements and awkward postures, which can strain the body (24). For example, teachers may spend extended periods with their necks bent forward or in a slightly bent posture. Previous research has shown that exposure to awkward postures can increase the prevalence of MSDs (29). School teachers frequently engage in prolonged standing, often three to four times per day. During standing lessons, teachers may slouch or shift their weight from one foot to the other, contributing to postural deterioration (30). Jo et al., (31) similarly found a strong association between prolonged standing and MSDs. Previous research has consistently identified prolonged sitting as a risk factor for musculoskeletal disorders (MSDs) (3). Many teachers, particularly those in public schools, use a similar type of chair in both the office and classroom, typically consisting of a metal frame with a plastic or upholstered seat and backrest (32). This type of chair is widely used in educational settings across Malaysia and is often referred to as a "standard chair" in local contexts. Prolonged sitting is common among school teachers due to their long working hours, which often involve computer work and correcting examination papers (28). Around nine out of ten teachers (86%) spend at least six hours a day sitting at their desks.

The prevalence of MSDs among teachers in this study ranged from 42.9 to 82.5%. This finding is comparable to previous research conducted in other Asian countries, where the prevalence of MSDs among teachers has been reported to be between 60.3 and 74.5% (33). The findings of this study align with previous research by Temesgen et al., (34) and Nyawose and Naidoo, (35), which identified lumbar back, neck, thoracic back, and shoulder injuries as the most common and severe

workplace injuries among teachers. However, Althomali et al., (36) also reported knee injuries as one of the most common injuries among school teachers, while wrists/hands and hips/thighs were identified as the least common. Although the main focus of the present study is to compare the prevalence of MSDs in public and international schools in Pahang, a major limitation of the study is the inclusion of risk factors that explain these differences. The teaching environment and the cultural factors under which the teachers perform their work could explain the presence of specific MSDs, especially in knee injuries. In contrast to previous studies (37) that reported a higher prevalence of knee injuries among school teachers, our findings revealed that knee injuries were among the least frequently reported complaints in this study, occurring in only 49.2% of cases.

As previously noted, the shoulder region exhibited the highest incidence rate of MSDs among school teachers in this study. These findings align with previous studies conducted among special education teachers in Sabah, which reported similar patterns of affected body regions (38). Poor shoulder flexibility among school teachers is likely to contribute to the high prevalence of MSDs in the shoulder regions by creating muscular imbalances, increasing muscle tension, and potentially impairing circulation and nerve function (35). While cultural attitudes may play a role in shaping the perception and reporting of work-related injuries, the observed prevalence of MSDs among teachers in this study is significantly higher than that reported in other countries, such as China (48.7%), Saudi Arabia (45.2%), Japan (35.4%), and Brazil (31.6%), suggesting a need for further investigation into specific factors contributing to the higher prevalence in Malaysian context (22 , 36). Potential explanations for these variations in shoulder pain prevalence may include differences in educational systems, study design, facilities offered for instructors, and sociocultural and economic factors (34). Neck pain was the second most common musculoskeletal disorder (MSD) among school teachers in this study. These findings align with previous research that has documented high prevalence rates of neck pain among school teachers. Ezugwu et al., (39) reported a prevalence of neck pain among female school teachers of 71.3%, which is slightly lower than the rate found in this study. Conversely, another study found a higher prevalence of neck pain, reaching 75.5%. Despite the high prevalence of neck pain, Ng et al., (28) reported that neck pain was among the least frequently reported MSDs by teachers, ranking ninth in their study.

Lower and upper back pain emerged as the most prevalent MSDs among school teachers in Pahang. This finding aligns with international research, which has also reported high prevalence rates of MSDs among school teachers (40). However, unlike previous studies that reported general back pain, this study specifically differentiated between lower and upper back, with lower back pain affecting 71.8% of the teachers, despite the prevalence of MSDs in other countries like Turkey (43.8%), Saudi Arabia (68.4%) and China (68.8%), the current study observed a higher prevalence of MSDs among teachers (7). Malaysian teachers might have a heavier workload than their counterparts in other countries. This could include longer teaching hours, larger class sizes, and more administrative duties, leading to increased physical strain and a higher risk of MSDs (41).

Upper back pain was the fourth most common musculoskeletal disorder (MSD) among school teachers in Pahang. The findings of this study align with previous research that has reported high incidence rates of MSDs among school teachers in secondary schools, with Syazwani et al., (42) reporting a prevalence of 85.2%, slightly higher than the rate observed in this study. However, other studies have identified upper back pain as one of the top five most common njuries among teachers, but with lower prevalence rates than in this study. For example, previous research in Botswana (52.6%), Turkey (36.9%), and Nigeria (69.2%) reported lower rates of upper back pain (43).

The hips/thighs region was the only body region that showed a significant difference between public and international schools in Pahang. The findings of this study are inconsistent with the prevalence of musculoskeletal disorders (MSDs) reported in Shah Alam, Malaysia (48.1%), Bolivia (31.9%), and Turkey (8.4%) (5). Additionally, a previous study reported a higher prevalence of hip/thigh pain, reaching 91.8% (43). Chronic exposure to ergonomic risk factors can lead to more severe problems, including symptoms and physical signs that may result in musculoskeletal disorders (MSDs) (44). Logistic regression analysis revealed a significant association between lifting heavy loads and lower back pain ($p=0.019$). This finding is consistent with previous research conducted in Athens, which reported a similar association between lifting heavy loads and low back pain among school teachers (45). A study conducted in Negeri Sembilan, Malaysia, reported a similar association between prolonged sitting and shoulder pain ($p=0.04$) (46). Additionally, research in China found that prolonged sitting was significantly associated with shoulder and lumbar back pain (43). Furthermore, Boukabache et al., (47) identified prolonged sitting as a risk factor for hip/thighs pain, suggesting that prolonged sitting can increase passive stiffness in the hip flexor muscles. Among the three body regions examined, prolonged sitting was the strongest predictor of shoulder pain prevalence.

Teachers play a crucial role in educating and preparing students for future success. Their contributions extend beyond the classroom, contributing to the overall improvement of society and the growth of future generations. Musculoskeletal disorders (MSDs) are a

prevalent and significant occupational health concern among teachers. While often overlooked, this issue has gained increasing attention in recent years. The demanding nature of the teaching profession often involves prolonged periods of head-down activities, such as reading, grading assignments, and writing on the board. Additionally, teachers frequently engage in risky behaviors, including prolonged sitting at a computer, standing for extended periods during class, and repetitive writing on the board (48). A Work Environment Impact Analysis (WEIA) was conducted to assess the school's conducive atmosphere, ergonomic workstations, and workplace safety. Before the start of the school day, teachers are required to wait at the main entrance for one hour to ensure all students have entered the school grounds safely. This practice exposes teachers to the ergonomic risk factor of prolonged standing. After welcoming students, teachers attend the assembly in the hall, which involves prolonged sitting for one hour.

The school session begins at 7:30 AM and ends at 2:00 PM. Teachers proceed to their respective classrooms to start teaching. The walk from the teacher's room to the classroom takes five to ten minutes, carrying various items like books. Some teachers need to climb stairs to reach their classrooms, with level 4 being the highest. This routine exposes teachers to the ergonomic risk factor of lifting heavy loads. Alias et al., (49) identified lifting and carrying heavy items like books, projectors, and other equipment as common job duties for school teachers. During teaching sessions, teachers are observed standing for 60 to 90 minutes, further exposing them to the ergonomic risk factor of prolonged standing. Syazwani et al., (42) found that school teachers in Shah Alam, Malaysia, frequently engage in prolonged writing on the upper part of the whiteboard and twisting motions, such as turning from the board to the class and back.

The WEIA revealed that female teachers in Pahang experienced similar ergonomic risks. Teachers frequently engage in overhead activities, such as writing on the upper part of the whiteboard with outstretched arms. This is often due to the height of the whiteboard, which some female teachers may find difficult to reach. Teachers also need to twist their bodies, particularly when turning from the board to the class and back, especially in primary schools. This is often necessary to focus on student questions. These activities contribute to prolonged standing and awkward posture. A study in Enugu, Nigeria, found similar findings, with teachers commonly working at overhead positions with outstretched arms, particularly when writing on the board or pointing at images (4).

After the end of a teaching session, teachers wait 30 to 45 minutes for students to complete their assigned activities. Once the class is finished, teachers return to the teacher's room to relax before preparing for the next class. Some teachers continue their tasks, such as grading homework and test papers, or using the computer for administrative tasks like preparing RPH (Daily Lesson Plans). The study revealed that many female teachers use standard chairs instead of ergonomic chairs. Kibria et al. (50) noted that inappropriate furniture is positively associated with musculoskeletal disorders (MSDs) among teachers. These factors contribute to prolonged sitting, awkward postures, and the use of uncomfortable furniture like standard chairs. At the end of the school day, teachers conduct a 30-minute meeting twice a week, further exposing them to the ergonomic risk factor of prolonged sitting.

CONCLUSION

In conclusion, the study found that public school teachers were exposed to ergonomic risk factors more frequently than international school teachers with 78.8% of heavy lifting ($x^2 = 67.4$, $p < 0.001$), 78.2% of awkward posture ($x^2 = 49.01$, $p < 0.001$), 81.8% of prolonged standing ($x^2 = 83.14$, $p < 0.001$), and 83.5% of prolonged sitting ($x^2 = 77.28$, $p < 0.001$) which may lead to a higher prevalence of musculoskeletal disorders (MSDs). Significant differences between public and international school teachers were observed in these body regions. Thus, public school teachers have significant prevalence of neck pain ($x^2 = 9.55$, $p = 0.002$), shoulder pain ($x^2 = 34.93$, $p < 0.001$), upper back pain ($x^2 = 9.22$, $p = 0.002$), lower back pain ($x^2 = 24.13$, $p < 0.001$) and hips/thighs pain ($x^2 = 35.81$, $p < 0.001$) compared with international school teachers. Logistic regression analysis was conducted to determine the association between ergonomic risk factors and MSDs. Therefore, the study find that heavy lifting was significantly associated with lower back pain (OR = 2.57, 95% CI = 1.168–5.636). Prolonged sitting was linked to shoulder pain (OR = 11.93, 95% CI = 2.488–57.166), lower back pain (OR = 2.53, 95% CI = 1.063–6.009), and hip/thigh pain (OR = 2.232, 95% CI = 1.033–4.819). Hence, prolonged sitting was found as the strongest predictor of MSDs, particularly shoulder pain, lower back pain and hip/thigh pain among both school teachers. Therefore, it is recommended for the government to provide an ergonomic chair and workstation to promote proper posture and reduce strain on the shoulders, lower back, and hips for the teachers. The teachers are encourage to have regular movement break, stretch or walk to reduce the duration of exposure.

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