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Work Posture Analysis Using Work Safe Office Ergonomics and Musculoskeletal Disorders (MSDs) in Teachers

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ABSTRACT

Background: Teachers are required to maintain prolonged sitting postures while engaging in complex and demanding tasks, placing them at increased risk for work-related musculoskeletal disorders (MSDs). Ergonomics plays a critical role in minimizing these risks, yet its importance is often underrecognized in the teaching profession. Moreover, in Indonesia, studies using direct observation methods such as the WorkSafe Ergonomics Tool remain limited. This study aims to analyse the relationship between work posture, assessed using the WorkSafe Ergonomic Office Tool, and musculoskeletal disorders among high school teachers. Methods: This study is an observational analytical study with a cross-sectional design on 55 Islamic Senior High School 3 teachers in Palembang City, who met the inclusion and exclusion criteria obtained using the total sampling technique. Data were obtained by filling out questionnaires and observing the work postures of teachers using the Ergonomic Office instrument by WorkSafe. Meanwhile, the musculoskeletal pain indicator uses the Numeric Rating Scale (NRS). Data were analyzed using the Chi-Square test. Results: The study results showed that most inappropriate work postures were found in the back in 78,2% of teachers and were significantly associated with pain in the head (p=0.033; OR=3.6) and back (p=0.046; OR=0.210). Conclusion: These findings highlight the urgent need for ergonomic adjustments in educational environments. Utilising approved observational instruments, such as the WorkSafe Ergonomic Office Tool, can improve early identification and preventative measures for musculoskeletal problems among teachers in Indonesia.

Keywords: work posture, musculoskeletal pain, ergonomics

INTRODUCTION

Musculoskeletal complaints occur due to damage to ligaments, tendons, or joints.(Pulek & Ma'Rufa, 2024) According to WHO, 1.71 billion people have musculoskeletal problems. The prevalence of musculoskeletal problems in Indonesia reaches 7.3%, and one of the musculoskeletal problems often occurs in the education sector, where the prevalence of musculoskeletal disorders in teachers is around 39% to 95%.(Azizie, 2022) Musculoskeletal pain is one of the health disorders that needs serious attention because, if not handled properly, it will impact the quality of life of the community (Main & de C Williams, 2002). Musculoskeletal pain can arise due to several factors, including biomechanical factors of the body and factors inherent in the individual's body, such as age, gender, and body composition. Biomechanical factors of the body include body posture, both when standing doing work (active or passive), sitting and lying positions, and the duration of staring at the screen (screen time). The weight of the load, frequency, duration and exposure to vibration also influences this (Punnett & Wegman, 2004). Physical activity factors can also determine the potential for musculoskeletal pain (Grabara, 2023).

The workload and role of teachers in teaching and learning activities are at risk of causing a teacher to experience work stress. Sitting in an inappropriate posture for a long time can cause musculoskeletal disorders or complaints.(Nadila et al., 2023; Rumeen et al., 2021) Based on the concept of ergonomics and body position, work posture is characterized by contraction and body movement that is not excessive and awkward posture, which is a body position that deviates from the neutral position. Improper work posture can cause discomfort when working. Examples of postures that are maintained for a long time are standing, sitting, squatting, lifting objects, and bending. In addition to triggering the emergence of musculoskeletal pain, improper work posture in a high frequency of spread and long duration can cause injury to disability and other musculoskeletal diseases(Niciejewska & Kasian, 2019).

This study was conducted to analyze the work posture of teachers in Palembang City in an effort to prevent musculoskeletal disorders that can interfere with the quality of education in schools. This can also disrupt the general teaching and learning system in schools.

METHODS

Study Design

This research is an observational, analytical study with a cross-sectional design.

Participants

The study involved 55 teachers from State Islamic Senior High School 3, Palembang City, who met the inclusion and exclusion criteria. The total sampling technique was used to recruit participants. Before participation, all respondents received a clear explanation of the study's purpose and procedures. Written informed consent was obtained from all participants.

Instruments

Primary data were collected using a structured questionnaire and direct observation. The questionnaire included sociodemographic information and musculoskeletal pain assessment using the Numeric Rating Scale (NRS), a validated tool widely used to measure pain intensity. Work posture was assessed using the Ergonomic Office Tool by WorkSafe, a standardized and observational checklist designed for office environments. While the original tool was developed in English, a translated and adapted version was used for consistency. The instrument has been shown in prior studies to have acceptable reliability for posture evaluation.

Ethical Approval

This study received ethical clearance from the Health Research Ethics Committee of Sriwijaya University (No 068-2025) and declared that the research protocol has been granted.

Data Analysis

The data were analyzed using the Chi-square test to determine the association between work posture and musculoskeletal complaints. The Odds Ratio (OR) was calculated to estimate the strength and direction of association between variables, as a relative measure of risk. A p-value < 0.05 was considered statistically significant.

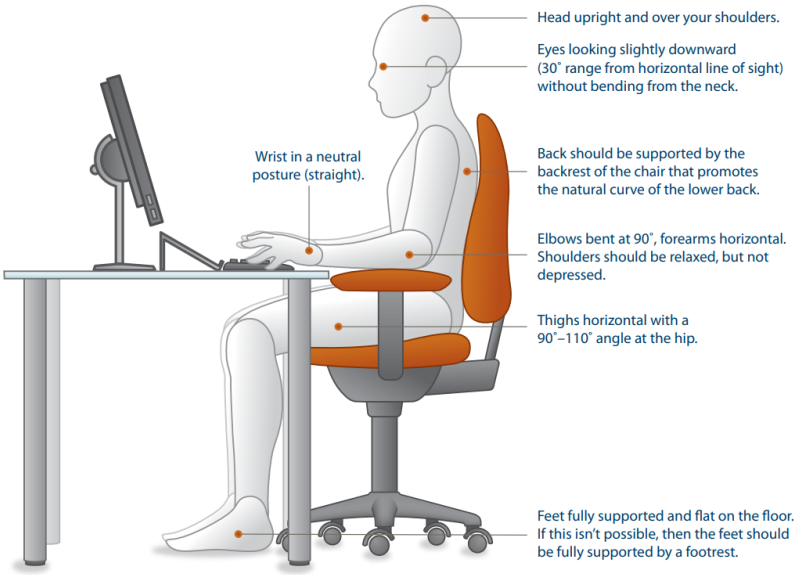

Figure 1. Ergonomic office by Worksafe (Posture Indicators)(Varatharaj et al., 2021)

RESULTS AND DISCUSSION

Primary data was obtained from the questionnaires filled out by MAN 3 Palembang City teachers. In this study, 80 teachers were willing to fill out the questionnaire, and 55 teachers met the inclusion criteria. The number of teachers included in the exclusion criteria was 25. They were not willing to be observed for work postures and had a history of musculoskeletal injuries and operations, so they were not included in the sample of this study.

The results of the analysis of the distribution of characteristics based on age obtained an average age of 41.93 years with a minimum age of 22 years and a maximum of 59 years, the most age ≥ 41 years as many as 28 people (50.9), the female gender is more, namely 40 years (72.7%), the body mass index is mostly ideal, namely 24 people (43.6%). The complete analysis results are presented in Table 1. The results of the analysis of the distribution of characteristics based on the age and length of use of work aids (gadgets) in teachers and the length of sitting are shown.

The duration of use of work aids (gadgets) is obtained on average 262.54 minutes with a minimum duration of 40 minutes and a maximum of 720 minutes. The duration of use of gadgets is categorized into >120 minutes and ≤ 120 minutes; most respondents use gadgets >120 minutes as many as 42 (76.4%). The analysis of the distribution of work stress in a teaching

profession showed that most respondents experienced mild work stress, as many as 49 people (89.1%). The complete analysis results are presented in Table 1.

Characteristic of Research Subject

Table 1. Respondent Characteristics based on demographic characteristics and gadget usage

Characteristics	n	(%)
Age		
- <41 years	27	49.1
- >=41 years	28	50.9
Gender		
- Man	15	27.3
- Woman	40	72.7
Body Mass Index		
- Underweight	6	10.9
- Ideal	24	43.6
- Overweight	10	18.2
- Obesity	15	27.3
Duration of use of work aids (gadgets)		
- >120 minutes	42	76.4
- ≤ 120 minutes	13	23.6
Job Stress		
- Currently	6	10.9
- Light	49	89.1
Total	55	100.0

The majority of the teacher population at MAN 3 Palembang is female, namely 40 people (72.7%), while the number of male teachers is 15 people (27.3%). The number of teachers dominated by women follows the distribution of teachers in Indonesia, recorded by the Ministry of Education, Culture, Research, and Technology; there are 2.36 million female teachers in the 2024/2025 academic year. (*Data Pokok Pendidikan*, 2023) The number of female teachers is greater than men, which is associated with the stigma that female teachers have perseverance, patience, and gentleness and can monitor changes in behaviour and the development of students. (Marlisa et al., 2020)Diah Firdausya's 2019 study showed that the dominance of women in the teaching profession is due to flexibility and also the ease of dividing time between work and household.(Firdausyah, 2019)

The distribution of BMI among MAN 3 teachers shows that the BMI of teachers in the normal category is 24 people (43.6%), followed by the obesity category of 15 people (27.3%), the fat category of 10 people (18.2%), and the thin category of 6 people (10.9%). The results of the BMI distribution among MAN 3 Palembang teachers are based on research conducted on vocational high school teachers in Palembang City in 2018, with the results showing that teachers predominantly have BMI in the normal category.(Choir, 2022) Working as a teacher affects a person's BMI, especially on the length of work, diet, and physical activity. Regular working hours mean that there is no need for additional daily calories; regular working hours can also help teachers to eat regularly so that they have a normal BMI.(Khairi et al., 2021; Maulana et al., 2019).

Work stress conditions cause the body to activate the sympathetic nervous system, which triggers the production of adrenaline and noradrenaline, which bind to G protein membrane receptors and then trigger the production of cyclic adenosine monophosphate, which activates cellular response. This activation causes the production of inflammatory mediators such as TNF-α, IL-1, IL-6, and histamine, which then, in the long term, can become maladaptive and painful. (Doda et al., 2020)Click or tap here to enter text.

In mild stress conditions, the body continues to produce stress hormones and is controlled by glucocorticoid hormones. However, in chronic conditions, the individual does not have good coping mechanisms, and there is a risk of experiencing *stress* mechanisms. *induced hyperalgesia*. The mechanism involves changes in nociceptor function, glutamatergic and serotonergic signalling changes, and the release of pro-inflammatory cytokines that stimulate the somatosensory cortex to interpret pain signals despite *the stressor.*(Imamah et al., 2023; Li et al., 2019)(Stojadinovic et al., 2012)

Work Postures

The analysis of the distribution of work postures using the *Office Ergonomics instrument by WorkSafe* and RULA includes the head, back, elbow, and wrist. The work posture of the head was not appropriate for 21 people (38.2%) based on the back, as many as 43 people (78.2%), based on the elbow as many as 32 people (58.2%) were not appropriate based on the wrist as many as 29 people (52.7%). The complete analysis results are presented in Table 2. Table 2 displays the distribution of respondents' work postures across various body regions. Improper posture was most commonly observed in the back (78.2%), followed by the wrist (61.8%), elbow (56.4%), and head (50.9%).

Table 2. Distribution of work postures using the *Office Ergonomics instrument by Worksafe*

Work posture	Number (n)	Percent (%)
Head		
- Improper	21	38.2
- Ergonomic/proper	34	61.8
Back		
- Improper	43	78.2
- Ergonomic/proper	12	21.8
Elbow		
- Improper	32	58.2
- Ergonomic/proper	23	41.8
Wrist		
- Improper	29	52.7
- Ergonomic/proper	26	47.3

Musculoskeletal Disorders

Table 3 shows that musculoskeletal complaints were most frequently reported in the upper back (67.3%), lower back (65.5%), and upper extremities (58.2%), which include the shoulders and arms. Lower extremity complaints were the least reported (20.0%).

Table 3. Distribution of Musculoskeletal Disorders

Work posture	Number(n)	Percent(%)
Pain in upper part 1		
- Yes	32	58.2
- No	23	41.8
Pain in upper extremities part 2	26	47.3
- Yes	29	52.7
- No		
Upper back pain		
- Yes	37	67.3
- No	18	32.7
Lower back pain		
- Yes	36	65.5
- No	19	34.5

Notes: Upper extremity part 1 (shoulder, upper arm); Upper extremities part 2 (elbow, under arm, wrist, and hand); upper back (neck and upper back); lower back (wraist, buttock and buttom).

The results of the NBM questionnaire showed that the population of teachers at MAN 3 Palembang complained of musculoskeletal pain, although not all teachers complained of pain. Each region had its proportion of pain complaints. Of all the regions experiencing pain, the three regions with the highest frequency of pain were the waist, right shoulder, and neck. The highest frequency of pain in these regions is similar to the research results on teachers in the Jabodetabek area. This study showed that the three regions with the highest pain presentation were the neck, shoulder, and back regions. (Subagio, 2022) The waist region, part of the lower back, is the most susceptible to pain. This can be associated with the biomechanical processes experienced by teachers when teaching, such as sitting posture, repeated standing-to-sitting movements, body twisting movements, and *furniture* that does not support ideal ergonomics, increasing the burden on the spine. These factors are some of the things that can be associated with the high incidence of pain in the waist. (Althomali et al., 2021; Fahmy et al., 2022) The right shoulder region is the region with the highest prevalence of pain after the waist. Pain in this region is associated with the teacher's habit of using computers and the habit of writing on the whiteboard. Regardless of the teacher's body proportions, using computers and writing on the repetitive blackboard triggers muscle fatigue, which triggers local inflammation. The right shoulder region is also dominant in a large population of teachers, so shoulder pain tends to be localized on the right side, not the left. (Althomali, 2022) Pain in the neck region then ranks third in this study's prevalence of musculoskeletal pain. The neck region is associated with the teacher's posture while using a laptop and writing on the blackboard. Writing on the blackboard while looking up causes *strain* on the neck muscles. In addition to posture, conditions that can affect pain are the shape of the chair and table used. Many teachers do not get chairs and tables that support ergonomics, so the risk of neck pain increases.

Association between Work Postures with Upper Extremity part 1 (Shoulder and upper arm)

Results of analysis of the relationship between work posture and musculoskeletal complaints It was found that there was a significant relationship between work posture and musculoskeletal complaints (upper extremity pain part 1) obtained p = 0.033 (p> 0.05), OR value = 3.600 and 95% CI (1.074-12.062) meaning that respondents whose work posture head is not appropriate have a risk of 3.600 times to experience musculoskeletal complaints (upper extremity pain part 1) compared to those whose work posture head is appropriate.

- **Head posture and upper extremity pain part 1 (Shoulder and upper arm)**: A significant association was found (p = 0.033; OR = 3.600; 95% CI: 1.076–12.063). Teachers with improper head posture were 3.6 times more likely to report upper extremity discomfort.
- **Back posture and upper extremity pain part 1 (Shoulder and upper arm)**: This association was also statistically significant (p = 0.046; OR = 0.213; 95% CI: 0.046–0.980), although the OR < 1 suggests that improper back posture may not be a direct risk factor for upper limb complaints.

Table 4 presents the relationships between specific body postures and musculoskeletal complaints in corresponding regions.

Table 4. Relationship between Working Posture and Musculoskeletal Disorders (upper extremity pain part 1)

Work posture	Musculoskeletal Disorders (upper extremity pain part 1)			p	OR 95% CI
	Yes n (%)	No n (%)	Total n (%)		
Head					
- Improper	16 (76.2)	5 (23.8)	21 (100.0)	0.033	3,600

- Ergonomic/proper	16 (47.1)	18 (52.9)	34 (100.0)		(1,074-12,062)
Back					
- Improper	22 (51.2)	21 (48.8)	43 (100.0)	0.046	0.210
- Ergonomic/proper	10 (83.3)	2 (16.7)	12 (100.0)		(0.041-1.071)
Elbow					
- Improper	19 (59.4)	13 (40.6)	32 (100.0)	1,000	1,124
- Ergonomic/proper	13 (56.5)	10 (43.5)	23 (100.0)		(0.380-3.327)
Wrist					
- Improper	19 (65.5)	10 (34.5)	29 (100.0)	0.373	1,900
- Ergonomic/proper	13 (50.0)	13 (50.0)	26 (100.0)		(0.642-5.623)

Notes: Upper extremity part 1 (shoulder, upper arm); Upper extremities part 2 (elbow, under arm, wrist, and hand)

Improper head posture was significantly associated with upper extremity complaints. The forward head position, common when looking at screens or reading while teaching, can increase tension in the trapezius and shoulder muscles. This is supported by Choobineh et al. (2011), who found that forward head posture increases the risk of neck and shoulder disorders in office and education workers. The association between improper back posture and upper extremity pain was statistically significant but showed an OR < 1. This unexpected result might be due to compensatory posture changes or low exposure duration. Alternatively, it may reflect a protective factor or sample-related bias. Prior studies have emphasized the link between poor back posture and lower back pain, but its impact on upper limbs may be indirect (Alexopoulos et al., 2014).

Association between Work Postures with Upper Extremity part 2 (elbow, under arm, wrist and hand)

Results of analysis of the relationship between work posture and musculoskeletal complaints (upper extremity pain part 2) it was found that there was no significant relationship between the work posture of the head (p=1,000), (back p=0,910), elbow (p=0,194) and wrist (p=0,131) with musculoskeletal complaints (upper extremity pain part 2) p>0.05. The complete analysis results are presented in Table 5

Table 5. Relationship between work posture and musculoskeletal complaints (upper extremity pain part 2) in high school teachers or equivalent in Palembang City

Work posture	Musculoskeletal Disorders (upper extremity pain part 2)			p	OR 95% CI
	Yes n (%)	No n (%)	Total n (%)		
Head					
- Improper	10 (47.6)	11 (52.4)	21 (100.0)	1,000	1.023
- Ergonomic/proper	16 (47.1)	18 (52.9)	34 (100.0)		(0.344-3.040)
Back					
- Improper	21 (48.8)	22 (51.2)	43 (100.0)	0.910	1.336
- Ergonomic/proper	5 (41.7)	7 (58.3)	12 (100.0)		(0.366-4.875)
Elbow					
- Improper	18 (56.3)	14 (43.8)	32 (100.0)	0.194	2.411
- Ergonomic/proper	8 (34.8)	15 (65.2)	23 (100.0)		(0.797-7.289)
Wrist					
- Improper	17 (58.6)	12 (41.4)	29 (100.0)	0.131	2.676
- Ergonomic/proper	9 (34.6)	17 (65.4)	26 (100.0)		(0.895-7.998)

Notes: Upper extremity part 1 (shoulder, upper arm); Upper extremities part 2 (elbow, under arm, wrist, and hand)

Neither elbow nor wrist posture showed significant relationships with upper extremity complaints. These results suggest that pain in these regions may not stem directly from static positioning alone, or that the exposure duration was insufficient to establish a measurable effect. Other confounding factors, such as repetitive motion or psychosocial stress, may play a more influential role (Cote et al., 2008).

Association between Work Postures with Upper Back (Neck, and upper back)

Results of analysis of the relationship between work posture and musculoskeletal complaints (upper back pain) it was found that there was no significant relationship between the work posture of the head (p=0.826), (back p=0.731), elbow (p=0.250) and wrist

(p=0.568) with musculoskeletal complaints (upper back pain) p>0.05. The complete analysis results are presented in Table 6

Table 6. Relationship between work posture and musculoskeletal complaints (upper back pain) in high school teachers or equivalent in Palembang City

Work posture	Musculoskeletal Disorders (upper back pain)			p	OR 95% CI
	Yes n (%)	No n (%)	Total n (%)		
Head					
- Improper	15 (71.4)	6 (28.6)	21 (100.0)	0.826	1.364
- Ergonomic/proper	22 (64.7)	12 (35.3)	34 (100.0)		(0.419-4.435)
Back					
- Improper	28 (65.1)	15 (34.9)	43 (100.0)	0.731	0.622
- Ergonomic/proper	9 (75.0)	3 (25.0)	12 (100.0)		(0.146-2.651)
Elbow					
- Improper	24 (75.0)	8 (25.0)	32 (100.0)	0.250	2.308
- Ergonomic/proper	13 (56.5)	10 (43.5)	23 (100.0)		(0.732-7.280)
Wrist					
- Improper	21 (72.4)	8 (27.6)	29 (100.0)	0.568	1.641
- Ergonomic/proper	16 (61.5)	10 (38.5)	26 (100.0)		(0.528-5.102)

Notes; upper back (neck and upper back); lower back (wraist, buttock and buttom)

Association between Work Postures with Lower back (Wraist, buttock, and buttom)

Results of analysis of the relationship between work posture and musculoskeletal complaints (lower back pain) it was found that there was no significant relationship between the work posture of the head (p=0.306), (back p=0.303), elbow (p=0.160) and wrist (p=0.1000) with musculoskeletal complaints (lower back pain) p>0.05. The complete analysis results are presented in Table 7

Table 7. Relationship between work posture and musculoskeletal complaints (lower back pain) in high school teachers or equivalent in Palembang City

Work posture	Musculoskeletal Disorders (lower back pain)			p	OR 95% CI
	Yes n (%)	No n (%)	Total n (%)		
Head					
- Improper	16 (76.2)	5 (23.8)	21 (100.0)	0.306	2.240
- Ergonomic/proper	20 (22.3)	14 (41.2)	34 (100.0)		(0.665-7.545)
Back					
- Improper	30 (69.8)	13 (30.2)	43 (100.0)	0.303	2.308
- Ergonomic/proper	6 (50.0)	6 (50.0)	12 (100.0)		(0.626-8.513)
Elbow					
- Improper	18 (56.3)	14 (43.8)	32 (100.0)	0.160	0.357
- Ergonomic/proper	18 (78.3)	5 (21.7)	23 (100.0)		(0.106-1.200)
Wrist					
- Improper	19 (65.5)	10 (34.5)	29 (100.0)	1,000	1.006
- Ergonomic/proper	17 (65.4)	9 (34.6)	26 (100.0)		(0.330-3.062)

Notes; upper back (neck and upper back); lower back (wraist, buttock and buttom)

Meanwhile, the insignificant results on the duration of sitting with back pain are supported by a study on teachers in Malaysia, which stated that there was no relationship between the duration of sitting of teachers and complaints of back pain (p = 0.316). (Zamri et al., 2020) However, the results differed from those of studies on teachers in Boyolali Regency (p = 0.002) and Bogor Regency (p = 0.001), which stated a significance between the duration of sitting and back pain. (Alya et al., 2023; Yanty et al., 2016)In other populations that have similarities with teachers' work patterns, the same results were obtained in a study on bank employees in Atambua City, which stated that there was no relationship between the duration of sitting and back pain, with a value of p =

1.000. (Corputty et al., 2021) This study reveals that the duration of sitting is not a single factor in the occurrence of back pain; there are multifactorial risk factors. (Corputty et al., 2021) Sitting for a long time causes a static condition of the supporting muscles of the body, so that the back muscles and spine experience anaerobic metabolism, resulting in the accumulation of lactate, which will inhibit and reduce oxygenation in muscle cells. This condition, in the long term, is at risk of becoming chronic inflammation and causing pain.(Lis et al., 2017)

Regarding physical risk factors, posture while sitting is one of the factors that cannot be separated from the duration of sitting. Posture plays an important role because the wrong posture when sitting is associated with decreased blood flow to the body, which supports the body; decreased blood flow causes *postural strain* and triggers muscle fatigue.(Lis et al., 2017)

Postural strain due to non-ideal posture can occur acutely and chronically. Acute events are caused by sudden movements of muscles, such as lifting weights and triggering muscle spasms. Chronic *strain events* are repeated acute events, causing structural abnormalities such as atrophy of the muscles and tissues around the muscles. This chronic phase can cause inflammation and back pain.(Beynon et al., 2019; SALWA F. ABDEL-MAJID & WAFAA A. ABDALLAH, 2022) Body posture also influences factors like strength*,* flexibility*,* and muscle endurance. Back muscle strength is important to prevent pain in the body, and exercise habits can support muscle strength to maintain the structure of the spine and connective tissue around the back. Conversely, weak muscles cannot maintain the stability of the spine, so the tissue tends to be ischemic and trigger a pain response.(Lee & Kang, 2016)

Muscle flexibility then becomes a postural factor that affects back pain. The spine receives more load if the thigh and hip muscles have low flexibility. Low muscle movement due to a lack of flexibility can also cause chronic pain in the muscles around the spine due to lactate accumulation in muscle tissue.(Ito et al., 2023) The factor most closely related to sitting time is muscle endurance, which is the ability of muscles to contract for a long time. In the context of back pain, lumbar extensor muscle endurance is important to maintain the body in a posture for a long time. (Spencer et al., 2019)Low muscle endurance can cause muscle fatigue more quickly so that the back loses support for sitting. When the muscles are tired, there is increased pressure on the spine, making the upper back susceptible to pain. In addition to increased load, low muscle endurance can cause delayed activation of supporting muscles or decreased neuromuscular control. If neuromuscular control of the back decreases, the risk of back pain increases.(Abass et al., 2020).

CONCLUSIONS

This study's findings are consistent with prior research showing a high prevalence of MSDs in teachers due to static posture, prolonged standing, and poor ergonomic environments. However, the specific association between head posture and upper limb complaints, such as those involving the shoulders and arms, strengthens existing evidence and highlights an important area for intervention. Limitations include the cross-sectional design, which prevents causal inference, and reliance on self-reported data, which may introduce recall bias. The sample size may also limit generalizability. This study highlights the importance of ergonomic awareness and interventions in educational settings. Postural education, workplace modification, and physical activity programs may help reduce MSDs among teachers.

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