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Musculoskeletal Discomfort among Tahfiz Students in Kelantan: A Cross-Sectional Study Using the Cornell Musculoskeletal Discomfort Questionnaire

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Research Article

Abstract:
Tahfiz educational institutions in Malaysia, especially in the state of Kelantan, show a unique learning practice of sitting cross-legged or kneeling on the floor throughout the learning process. Although this practice aligns with local culture and tradition, it can lead to physical discomfort and musculoskeletal system problems among students. This study aimed to assess the level and distribution of physical discomfort among tahfiz students using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). A cross-sectional study was conducted among 110 tahfiz students in Kota Bharu, Kelantan, selected through convenience sampling. Data on demographic characteristics and learning posture were collected alongside CMDQ measures covering discomfort location, frequency, severity, and impact on learning. Data were analyzed using SmartPLS 4 (version 4.1.0.9). Of the participants, 80.9% were male and 19.1% were female. The most frequently reported musculoskeletal discomfort was in the lower back (16.9%), followed by the waist (11.2%), the upper back (9.2%), and the lower right leg (8%). SmartPLS analysis revealed that only body weight was significantly associated with the level of musculoskeletal discomfort ($\beta = 0.279$, $t = 2.214$, $p = 0.027$), indicating that students with higher body weight experienced greater discomfort during prolonged floor-sitting. Lower back discomfort emerged as the most prevalent complaint, highlighting the ergonomic risks associated with traditional learning postures. This study provides novel evidence as one of the first ergonomic assessments conducted in a Malaysian religious education setting using the CMDQ. The findings underscore the need for targeted ergonomic interventions to reduce musculoskeletal discomfort and enhance students' physical well-being and learning experience in tahfiz institutions.

Keywords: Sitting on the floor; Musculoskeletal disorders (MSD); Cornell Musculoskeletal Discomfort Questionnaire (CMDQ); School students; Posture comfort

1. INTRODUCTION

Non-ergonomic sitting postures have long been associated with musculoskeletal disorders (MSDs), particularly when individuals remain in static positions for prolonged periods (1). Inadequate seating support and forward-bending postures significantly increase intervertebral disc pressure, which can reach up to 140% of that experienced in a standing position (2). Numerous studies have established a clear association between poor sitting posture and MSDs such as lower back pain, neck pain, and chronic muscle tension (3, 4). In educational settings, these conditions not only affect physical health but also impair students' concentration, learning engagement, and productivity (5).

In Malaysia, floor-sitting postures remain common in certain educational contexts, particularly within tahfiz institutions where students traditionally sit cross-legged or kneel during Quranic learning and religious instruction. Although culturally embedded, prolonged floor-sitting without adequate lumbar or postural support has been shown to increase biomechanical stress on the lumbar spine and lower extremities (6, 7). Recent local evidence indicates a high prevalence of MSDs among Malaysian students, with the lower back, shoulders, and neck being the most affected regions (8).

Biomechanical and electromyography studies further demonstrate that extended floor-sitting alters muscle activation patterns and reduces lumbar curvature, thereby increasing spinal disc loading and soft-tissue strain (9, 10). Similar findings in school ergonomics research highlight that the absence of ergonomic furniture contributes to awkward postures and

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higher musculoskeletal complaints among students (11). Recent studies on school ergonomics and student sitting postures highlight persistent musculoskeletal risks associated with prolonged static postures and non-ergonomic learning environments (8, 12, 13).

Despite the widespread practice of floor-sitting in tahfiz institutions across Malaysia, ergonomic evaluations within this educational setting remain limited. Most existing studies focus on conventional classroom environments, leaving a significant gap in understanding MSD risks among tahfiz students who learn primarily on the floor. Therefore, this study aims to assess the severity and distribution of musculoskeletal discomfort among tahfiz school students using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), providing evidence to support ergonomically informed interventions in religious education settings.

2. MATERIALS & METHODS

2.1 Ethical Considerations

The ethical approval for this study was obtained from the University Ethical Committee with the reference number of UMK.A02.600-8/5/1 JLD 6(21). A permission was also secured from the participating tahfiz schools with the written informed consents, obtained from students' guardians. The participation was voluntary and anonymous.

2.2 Study Design

This study employed a quantitative cross-sectional design, conducted at a single point in time to assess musculoskeletal discomfort among tahfiz students who practise prolonged floor-sitting during learning activities. Data were collected using a structured questionnaire, including CMDQ, and analysed quantitatively using Partial Least Squares–Structural Equation Modelling (PLS-SEM). This design was chosen to identify the prevalence and associated factors of musculoskeletal discomfort within the study population.

2.3 Participants

The study was conducted in three tahfiz schools located in Kota Bharu, Kelantan, where Quranic learning is primarily conducted while sitting on the floor. Participants consisted of students aged 10 to 16 years who were actively enrolled in tahfiz programmes at the time of data collection.

2.4 Sampling Method and Sample Size

2.4.1 Sampling Method

A convenience sampling approach was adopted due to accessibility constraints and the need to obtain institutional permission. Schools and students were selected based on specific inclusion criteria, namely that the schools practised floor-based learning without the use of chairs or tables, students spent a minimum of four hours per day sitting on the floor for learning activities, students were aged between 10 and 16 years, and were actively attending tahfiz classes at the time of data collection. Students were excluded from the study if they had a history of severe musculoskeletal injury, had been diagnosed with neurological or musculoskeletal disorders, or were undergoing ongoing medical treatment related to bones or muscles. Convenience sampling may limit the generalisability of findings; however, it was considered appropriate for this exploratory ergonomic assessment within a specific educational context (14). This limitation is acknowledged and addressed in the discussion section.

2.4.2 Sample Size Determination

Based on an estimated population of approximately 150 tahfiz students across the three selected schools, the Krejcie and Morgan (15) sample size table was used to determine the minimum required sample size. At a 95% confidence level and 5% margin of error, the recommended sample size was 108 participants. A total of 110 students participated in this study, exceeding the minimum requirement and deemed statistically adequate for analysis using SmartPLS, which is suitable for small to medium sample sizes in exploratory research models.

2.5 Data Collection Tools

2.5.1 Demographic and Health-Related Questionnaire

A self-administered questionnaire was used to collect demographic and health-related information, including age, gender, height, weight, average daily duration of floor-sitting, and length of study at the tahfiz school. Health-related questions assessed recent experiences of musculoskeletal discomfort, a history of injury, the presence of chronic illness, and current medical treatment for muscles or bones.

2.5.2 Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) developed by Hedge *et al.* (16) was used to assess musculoskeletal discomfort (Figure 1). The CMDQ evaluates discomfort across 20 body regions, including the neck, shoulders, upper and lower back, upper and lower limbs. The instrument measures: Location of discomfort, Frequency of discomfort (never, 1–2 times/week, 3–4 times/week, once daily, several times daily), Severity and impact on learning activities during the previous week.

The CMDQ is widely recognised as a valid and reliable tool for assessing musculoskeletal discomfort in both educational and occupational settings. In this study, the questionnaire was administered in Malay, and minor wording adjustments were made to ensure comprehension among tahfiz students. A pilot test was conducted with a small group of students to confirm clarity and suitability.

Internal consistency analysis demonstrated acceptable reliability, with Cronbach's alpha and composite reliability values exceeding 0.70, indicating good internal consistency for the study population. The questionnaire was distributed after learning sessions to ensure accurate recall of discomfort, following established procedures used in similar educational ergonomics studies (16). A researcher was present to provide clarification when required.

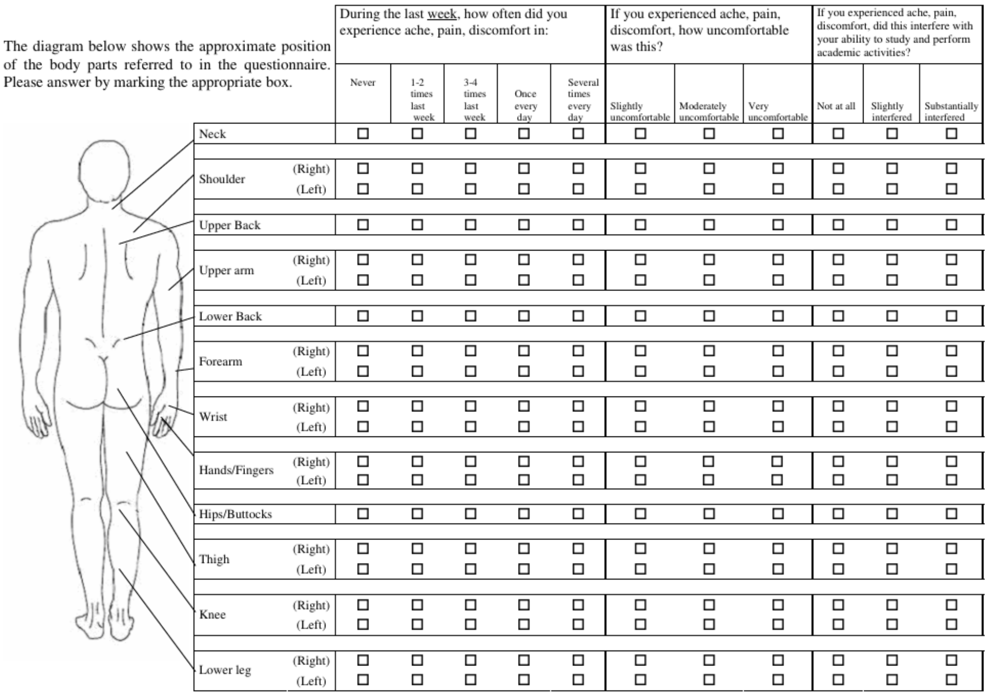

Figure 1. Cornell Musculoskeletal Disorder Questionnaire (CMDQ).

2.6 Observational Assessment

In addition to the questionnaire, non-intrusive classroom observation was conducted during learning sessions to document natural sitting postures and spontaneous posture changes. Observations focused on posture variation, duration of maintained postures, and movement patterns in response to discomfort. Three dominant postures were identified: cross-legged sitting, kneeling, and sitting with one leg raised.

2.7 Data Analysis

Questionnaire data were coded and analysed using SmartPLS version 4. Descriptive statistics were used to summarise demographic characteristics and discomfort prevalence. Measurement and structural models were analysed using PLS-SEM, which was selected due to its suitability for exploratory analysis, non-normal data distributions and small to moderate sample sizes. PLS-SEM also allows simultaneous analysis of multiple relationships between variables, making it appropriate for assessing the influence of demographic factors on musculoskeletal discomfort. Statistical significance was evaluated at a 95% confidence level ($p < 0.05$).

3. RESULTS

Observations conducted during learning sessions showed that tahfiz students in Kota Bharu adopted various floor-sitting postures and naturally changed posture after a certain period. These posture changes indicated discomfort or the need to redistribute the body's support load during prolonged sitting.

The mean age of the participants was 13.61 years (SD = 1.82). Participants' heights ranged from 117.00 cm to 185.00 cm, with a mean height of 152.56 cm (SD = 12.66). The average body weight was 46.79 kg (SD = 15.82). Students spent an average of 8.26 hours per day (SD = 1.20) sitting on the floor during learning sessions, and their average duration of study in tahfiz schools was 1.56 years (SD = 1.00). These demographic characteristics are summarised in Table 1.

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Table 1. Mean and standard deviation of participant demographics.

Characteristics	Mean	SD	Minimum	Maximum
Age (years)	13.61	1.82	10.00	16.00
Height (cm)	152.56	12.66	117.00	185.00
Weight (kg)	46.79	15.82	20.10	91.60
Sitting time (hours)	8.26	1.20	6.00	12.00
School experience (years)	1.56	1.00	0.3	2.5

*SD = Standard deviation

Observational data from the three tahfiz schools indicated that the cross-legged posture was the most frequently adopted sitting position, recorded a total of 85 times across all schools. This was followed by sitting with the right leg raised (82 occurrences) and kneeling (57 occurrences), as shown in Table 2.

Table 2. Frequency of sitting postures during study activities in three tahfiz schools.

Sitting Posture	Tahfiz 1	Tahfiz 2	Tahfiz 3	Total
Cross-legged	33	26	26	85
Sitting with the right leg raised	19	45	18	82
Kneeling	13	28	16	57

Structural model analysis using SmartPLS in Table 3 revealed that body weight was the only demographic variable significantly associated with musculoskeletal discomfort ($\beta = 0.279$, $t = 2.214$, $p = 0.027$). Other variables, including age, gender, height, sitting duration, and length of study experience, did not show statistically significant relationships with discomfort levels. The structural model demonstrated a moderate explanatory power ($R^2 \approx 0.18$), indicating that body weight accounted for a meaningful proportion of the variance in discomfort.

Table 3. Path coefficients, t-values and p-values between discomfort and demographic variables using SmartPLS.

Path	β (Path Coeff.)	T-value	P-value
Age → Discomfort	-0.001	0.004	0.997
Gender → Discomfort	0.234	0.771	0.441
Height → Discomfort	-0.164	0.944	0.345
Weight → Discomfort	0.279	2.214	0.027*
Sitting Time → Discomfort	-0.004	0.038	0.970
School Experience → Discomfort	-0.178	1.541	0.123

Analysis of the CMDQ showed that the lower back was the most frequently reported area of discomfort (16.9%), followed by the waist (11.2%), upper back (9.2%), and lower right leg (8%). The distribution of discomfort across body regions is illustrated in Figure 2.

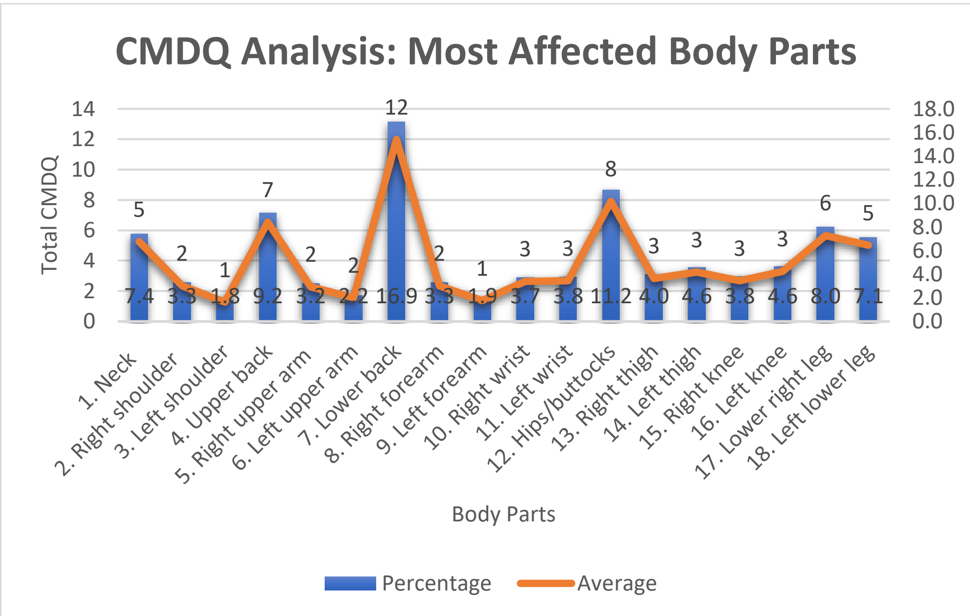

Figure 2. CMDQ analysis to find the most affected body parts among tahfiz students when sitting on the floor.

4. DISCUSSION

The frequent posture changes observed among tahfiz students indicate that prolonged floor-sitting creates physical discomfort that necessitates continuous adjustment. This behavioural response is consistent with earlier findings that static sitting postures maintained over extended periods negatively affect physical comfort, concentration, and academic engagement (17). Although posture shifting serves as a natural coping mechanism to redistribute musculoskeletal load, repeated adjustments may disrupt sustained attention during learning activities.

The dominance of the cross-legged posture among students is likely influenced by cultural familiarity and its perceived suitability for floor-based learning. However, no single posture appeared to provide sustained comfort, as evidenced by frequent transitions between cross-legged sitting, kneeling, and sitting with one leg raised. From a biomechanical perspective, prolonged floor-sitting often results in reduced lumbar curvature, increased hip flexion, and uneven load distribution across the lower limbs. These postural characteristics increase compressive forces on the lumbar spine and contribute to muscle fatigue in the trunk and lower extremities, particularly when lumbar support is absent.

The finding that body weight was the only significant predictor of musculoskeletal discomfort can be explained through biomechanical mechanisms. Heavier students are subjected to greater compressive loads on spinal structures and weight-bearing joints during prolonged sitting. Increased body mass amplifies intervertebral disc pressure and accelerates muscle fatigue as postural muscles must exert greater force to maintain stability without external support. This finding aligns with biomechanical principles and previous ergonomics research showing that higher body weight increases mechanical stress on musculoskeletal tissues, particularly during sustained static postures (6).

The moderate explanatory power of the structural model ($R^2 \approx 0.18$) further suggests that musculoskeletal discomfort among tahfiz students is influenced by multiple interacting factors, with ergonomic exposure acting as the dominant contributor. This observation aligns with the cumulative load theory of musculoskeletal strain, which proposes that discomfort and injury result from repeated or prolonged exposure to low-level mechanical loading rather than from single high-intensity events (Karsh, 2006). In the context of tahfiz education, prolonged daily floor-sitting represents a cumulative biomechanical stressor that affects students regardless of age or gender, explaining the lack of significant demographic effects beyond body weight.

Lower back discomfort emerged as the most prevalent complaint among students, which is consistent with previous research showing that prolonged sitting without lumbar support increases spinal disc pressure and compromises natural spinal curvature (8). Occupational health guidelines emphasise the importance of maintaining lumbar support to reduce musculoskeletal strain (18). The absence of ergonomically designed seating in tahfiz classrooms therefore represents a significant risk factor, particularly for students who are still undergoing physical growth and development.

Comparable findings have been reported in other cultural and educational contexts where floor-sitting is common. Studies conducted in Japanese classrooms, Indian gurukul-style schools, and Middle Eastern religious learning environments similarly report increased lower back and lower limb discomfort associated with prolonged floor-sitting during study or religious instruction. These studies highlight that while floor-sitting may support cultural identity and tradition, it also presents consistent ergonomic challenges across different cultural settings, reinforcing the global relevance of the present findings (6, 7).

Although floor-sitting is a culturally rooted practice that symbolises simplicity and spirituality in religious education (7), educational ergonomics research consistently demonstrates that non-ergonomic learning environments are associated with increased musculoskeletal complaints and awkward postures among students (11). Therefore, maintaining traditional learning practices should be complemented by ergonomically informed modifications rather than replaced entirely.

From a practical perspective, several interventions can be considered to mitigate musculoskeletal risks while respecting cultural norms. First, ergonomic redesign of the learning environment using culturally appropriate solutions such as low tables, lumbar-support cushions, or inclined reading stands can help maintain a more neutral spinal posture. Second, scheduled movement breaks, for example five minutes every 30–45 minutes, can reduce cumulative static loading and muscle fatigue. Third, posture education and ergonomic awareness training for tahfiz teachers can play a crucial role in guiding students toward healthier sitting habits and encouraging regular posture variation during learning sessions (12).

Overall, the findings underscore the importance of integrating ergonomic principles into floor-based religious education systems. By adopting culturally sensitive ergonomic strategies, tahfiz institutions can preserve traditional learning practices while safeguarding students' musculoskeletal health and supporting long-term learning performance. This study provides a solid basis for developing specific ergonomic guidelines for religious educational institutions that practice floor sitting.

5. CONCLUSION

This study demonstrates that the practice of prolonged floor-sitting, which is common in tahfiz educational institutions, has the potential to affect students' musculoskeletal health, particularly when such postures are maintained without adequate ergonomic support. Based on subjective assessment using the CMDQ, the lower back emerged as the most frequently reported area of discomfort among students. While respecting the cultural and religious significance of floor-based learning, it is essential to integrate ergonomic principles to safeguard students' physical well-being and support effective learning.

Several limitations should be acknowledged. The cross-sectional design restricts causal inference, the assessment relied on self-reported discomfort, and the study was limited to tahfiz schools within a single district. Despite these limitations, the findings provide valuable preliminary evidence on musculoskeletal risks in religious education settings. Future research should incorporate objective posture and biomechanical assessments, such as Rapid Entire Body Assessment (REBA), inclinometer measurements, or electromyography (EMG), as well as longitudinal tracking of musculoskeletal symptoms to better understand cumulative exposure and long-term health outcomes.

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Overall, the findings highlight the importance of adopting a holistic and culturally sensitive ergonomic intervention approach to improve student comfort, reduce the risk of musculoskeletal strain, and enhance learning effectiveness in tahfiz institutions.

AUTHORSHIP CONTRIBUTION STATEMENT

Raihan Azzahra Ahmad Kamal: conceptualisation, data collection, formal analysis, writing - original draft; Darliana Mohamad: study design, supervision, methodology development, writing - review & editing; Nooraziah Ahmad: statistical analysis support, writing - review & editing; Dian Darina Indah Daruis: technical consultation, writing - review & editing; Mohd Firdaus Mahamad Ali: data collection, field coordination; Azmul Fadhli Kamaruzaman: data verification, writing - review & editing.

DATA AVAILABILITY

Data is available on request.

DECLARATION OF COMPETING INTEREST

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI

Generative AI tools were used only for language editing and grammar refinement. The authors take full responsibility for the content and integrity of the manuscript.

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