ORIGINAL ARTICLE

Uncovering Novel Association of Physical Activity with Shoulder Pain and Depression Among Spinal Cord Injury Community In Klang Valley, Malaysia

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ABSTRACT

Background & Objectives: Individuals with spinal cord injury (SCI) commonly experience shoulder pain and depressive symptoms, which can limit daily functioning and quality of life. Although physical activity is often encouraged in SCI rehabilitation, its relationship with pain and depression in urban community settings remains unclear. This study aimed to examine the associations between physical activity, shoulder pain, and depressive symptoms among adults with SCI living in the Klang Valley, Malaysia. **Methods:** A cross-sectional study was conducted among wheelchair-dependent adults with SCI aged 18–55 years residing in the Klang Valley. Participants were recruited using snowball sampling and assessed face-to-face. Physical activity, shoulder pain, and depressive symptoms were measured using validated Malay versions of the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD), Wheelchair User's Shoulder Pain Index (WUSPI), and Patient Health Questionnaire-9 (PHQ-9), respectively. Associations between variables were examined using Spearman's rank correlation. **Results:** Eighteen participants were included. The mean PASIPD score indicated moderate physical activity levels, while shoulder pain severity showed wide inter-individual variability. Most participants reported minimal depressive symptoms. No significant associations were observed between physical activity and shoulder pain (ρ = –0.030, p = 0.904) or between physical activity and depressive symptoms (ρ = 0.105, p = 0.679). Years since injury were also not significantly associated with shoulder pain or depressive symptoms. The consistently weak correlations suggest that physical activity levels and pain or depression varied largely independently within this urban SCI cohort. **Conclusion:** In this urban SCI sample, physical activity was not significantly associated with shoulder pain or depressive symptoms. These findings suggest that pain and psychological well-being may be influenced by factors beyond activity level alone. Larger, longitudinal studies are needed to further explore these relationships and inform context-specific rehabilitation strategies.

Keywords: Physical activity, pain, depression, spinal cord injury, Malaysia

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INTRODUCTION

Spinal cord injury (SCI) results from traumatic causes such as motor vehicle accidents, falls, sports injuries, and violence, as well as from non-traumatic conditions including tumours, infections, vascular disorders, and degenerative diseases. Depending on the neurological level and severity of injury, SCI may result in paraplegia or tetraplegia, leading to varying degrees of motor, sensory, and autonomic impairment (Harvey, 2008). As a consequence, individuals with SCI frequently experience limitations in balance, mobility, safety awareness, and independence in daily, social, and vocational activities, which collectively contribute to a substantial reduction in quality of life.

Within the rehabilitation continuum, individuals with SCI often achieve adequate levels of physical activity during supervised inpatient rehabilitation. However, following discharge into the community, physical activity levels decline sharply, falling well below those of the general

population (Nooijen et al., 2016; Hisham et al., 2022). This decline is further exacerbated by reduced physical capacity and difficulties performing basic activities of daily living, increasing the risk of secondary complications such as cardiovascular disease and metabolic disorders (Hicks et al., 2011). Consequently, maintaining physical activity has become a central priority in long-term SCI rehabilitation. In addition to physical health benefits, exercise has been shown to improve psychological well-being and may promote neuroplasticity through mechanisms such as increased expression of brain-derived neurotrophic factor.

Despite these benefits, shoulder and upper-limb pain remains one of the most prevalent and disabling complications among manual wheelchair users with SCI. Daily reliance on the upper limbs for wheelchair propulsion, transfers, weight-shifting, and load-bearing tasks leads to repetitive mechanical stress and overuse injuries (Harvey, 2008). As a result, shoulder and upper-limb pain reduces independence, limits mobility, and significantly restricts engagement in physical activity. Evidence indicates that adherence to recommended physical activity guidelines is substantially lower among wheelchair users who experience shoulder pain, highlighting pain as a major barrier to sustaining an active lifestyle (Hisham et al. 2022). Furthermore, the relationship between physical activity and pain is complex and pain-type dependent, with neuropathic pain often decreasing with higher activity levels, while musculoskeletal and shoulder pain may vary depending on underlying mechanisms.

In parallel with physical complications, psychological challenges are highly prevalent following SCI. Depression, anxiety, fatigue, and post-traumatic stress symptoms are frequently reported and negatively influence rehabilitation outcomes, participation, and physical activity engagement (Williams & Murray, 2015; Kennedy et al., 2006). Among these, depression is particularly important, as it is one of the strongest predictors of poor functional outcomes following SCI. Importantly, pain, physical inactivity, and depression are increasingly recognised as interrelated rather than independent sequelae of SCI.

From a population health perspective, physical inactivity and psychological distress are already well-documented concerns in Malaysia, particularly within the Klang Valley. A cross-sectional study conducted in urban primary health clinics in the Klang Valley reported high prevalence of depression (20.5%), anxiety (44.5%), and stress (10.1%) among adults, highlighting the substantial mental health burden in this urban region (Abd Rahman et al., 2020).

Similarly, an earlier Klang Valley study among women working in the electronics industry demonstrated that individuals who engaged in regular physical activity reported significantly lower levels of depression and stress compared with sedentary workers, indicating a protective effect of physical activity on mental health in this urban Malaysian context.

More recently, a Klang Valley study conducted during the COVID-19 pandemic showed that lifestyle disruption and reduced activity were significantly associated with higher perceived stress levels among parents, further reinforcing the link between activity patterns and psychological outcomes in this region.
However, despite this growing body of Klang Valley-specific evidence in the general population, no study has examined these relationships within the SCI population. Existing Malaysian SCI studies have primarily focused on physical inactivity prevalence or functional outcomes at the national level (Ong et al., 2025), without concurrently examining physical activity behaviour, shoulder and upper-limb pain, and depression within a single SCI cohort. Moreover, local studies conducted in Kuala Lumpur and surrounding areas have tended to address healthcare utilisation or general rehabilitation outcomes (Yee Xing You et al., 2021; Zainudin et al., 2025), rather than integrative biopsychosocial relationships.

This gap is particularly important in the Klang Valley, Malaysia's most urbanised and densely populated region, which has the highest concentration of individuals with SCI and the greatest access to specialised rehabilitation services. Evidence from urban Klang Valley populations suggests that psychological distress and physical inactivity remain prevalent despite service availability (Abd Rahman et al., 2020). In addition, Malaysia's multicultural context, characterised by diverse cultural beliefs, gender roles, family structures, and socioeconomic conditions, may further influence pain perception, emotional coping, and engagement in physical activity, underscoring the need for context-specific investigation.

In response to these gaps, the present study aimed to examine the relationship between physical activity levels, shoulder and upper-limb pain, and depression among individuals with SCI residing in the Klang Valley, Malaysia. Based on existing international evidence and local Klang Valley findings demonstrating associations between physical activity and mental health in non-SCI populations (Abd Rahman et al., 2020), the following hypotheses were proposed:

  • Higher levels of physical activity are associated with lower levels of depression among individuals with SCI.
  • Higher levels of physical activity are associated with lower levels of shoulder and upper-limb pain.
  • Greater shoulder and upper-limb pain is associated with higher levels of depressive symptoms.

By addressing these hypotheses, this study seeks to generate region-specific evidence to inform targeted, culturally responsive rehabilitation strategies that optimise pain management, promote physical activity participation, and improve quality of life among

individuals with SCI living in urban Malaysia.

MATERIALS & METHODS

Study design
This study employed a cross-sectional observational design involving adults with SCI aged 18 to 55 years. Data were collected exclusively through face-to-face assessments, during which participants completed interviewer-administered questionnaires assessing physical activity levels, shoulder pain, and depressive symptoms. Although online surveys are commonly used in community-based research, a face-to-face approach was intentionally adopted in this study to ensure data accuracy, inclusivity, and participant comprehension, particularly given the physical and functional limitations experienced by individuals with SCI.

Eligible participants were required to be wheelchair-dependent and classified within the American Spinal Injury Association Impairment Scale (AIS) grades A, B, or C, and to possess adequate proficiency in either Malay or English to comprehend and respond to the questionnaires. Individuals were excluded if they were pregnant or had progressive medical conditions that could negatively impact their quality of life or limit their engagement in physical activity. Participants provided sociodemographic and injury-related information, including age, gender, injury duration and level, state of residence, type of residential area, educational attainment, and employment status.

Recruitment was conducted using a non-probability snowball sampling approach, in which initial respondents were invited to disseminate study information to their networks of individuals with SCI. This recruitment strategy was selected due to the absence of a centralized SCI registry in Malaysia and the practical challenges of accessing this population in the community. Recruitment continued iteratively until the study's achievable sample size was reached within the study period.

Setting
This study was conducted among community-dwelling adults with SCI residing in the Klang Valley, Malaysia. The Klang Valley, also known as greater Kuala Lumpur, refers to the densely populated metropolitan region encompassing Kuala Lumpur and its surrounding districts, including major urban areas in Selangor such as Petaling Jaya, Shah Alam, Subang Jaya, Ampang, and Klang. It is the most urbanized and economically developed region in the country, with the highest concentration of individuals living with SCI and the most consistent access to specialized rehabilitation and healthcare services (Zainudin et al., 2025). These characteristics make the Klang Valley an appropriate setting for exploring relationships between physical activity, shoulder pain, and depression among individuals with SCI within an urban Malaysian context.

Sampling and subjects
Participants were recruited using a non-probability snowball sampling method. Initial respondents were identified through rehabilitation centres, patient support networks, wheelchair-user communities, and social groups for individuals with SCI. These respondents were then invited to share the study information with other eligible individuals within their networks.

Eligible participants were aged 18-55 years, wheelchair-dependent, and classified as AIS grades A, B, or C. Proficiency in either Malay or English was required to ensure adequate understanding of the interview and outcome measures. Individuals who were pregnant or who had progressive medical conditions that could affect mobility, physical activity, or psychological status were excluded.

A total of 18 participants were recruited and completed the study assessments. Given the small sample size, this study was designed as an exploratory investigation rather than a hypothesis-testing study with sufficient statistical power. No a priori power analysis was conducted due to limited preliminary data on effect sizes within the Malaysian SCI population and constraints related to recruitment feasibility. The findings should therefore be interpreted with caution and viewed as preliminary evidence to inform future larger-scale studies.

Data Collection Procedure
All data were collected face-to-face to ensure accuracy, consistency, and completeness of responses. This approach was particularly important as individuals with SCI may experience reduced hand function, fatigue, limited digital access, or difficulty completing self-administered questionnaires independently. Data collection was conducted directly in community settings, enabling the researcher to reach individuals with limited access to hospital-based services and ensuring inclusivity across diverse living circumstances.

Face-to-face administration enabled the researcher to provide immediate clarification, guide participants through each questionnaire item, and minimise response errors, particularly for sensitive topics such as shoulder pain and depressive symptoms. Data collection sessions were conducted in private, quiet settings to ensure comfort and confidentiality, and written informed consent was obtained before participation.

Sociodemographic and injury-related information were obtained through structured interviews, including age, gender, race, marital status, educational level, employment status, household income, state, and type of residence, years since injury, wheelchair dependency, and neurological level of injury. Participants confirmed their AIS classification (A, B, or C) through self-report or available clinical documentation.

Following this, participants completed the Malay

versions of all outcome measures. Standardised instructions were provided, item meanings were clarified when necessary, and assistance was given to participants who required help due to limited hand function or fatigue. Each data collection session lasted approximately 30–45 minutes, after which data were checked for completeness and securely stored in accordance with approved ethical procedures.

Outcome Measures

Physical Activity Level
Physical activity was assessed using the Malay version of the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD). The PASIPD is an adaptation of the 10-item Physical Activity Scale for the Elderly (PASE) and evaluates recreational, household, and work-related activities performed over the previous seven days. Activity scores were calculated by multiplying reported duration by corresponding metabolic equivalent (MET) values to generate a composite physical activity score. The PASIPD has demonstrated acceptable reliability (Spearman correlation = 0.77) and validity among individuals with SCI (Washburn et al., 2002; van der Ploeg et al., 2007).

Pain Level
Shoulder pain was evaluated using the Malay version of the Wheelchair User's Shoulder Pain Index (WUSPI). The WUSPI consists of 15 items that assess pain intensity during wheelchair-related and functional tasks, such as propulsion, transfers, and overhead activities. Each item is scored on an 11-point scale (0–10), yielding a total score up to 150, with higher scores indicating greater pain severity. The WUSPI demonstrates excellent internal consistency (Cronbach's alpha = 0.98) and is widely used among wheelchair users (Curtis et al., 1995).

Depression Level
Depressive symptoms were measured using the Malay version of the Patient Health Questionnaire-9 (PHQ-9). Participants rated symptom frequency over the past 2 weeks on a 4-point scale (0–3), yielding total scores ranging from 0 to 27. Scores of 10 or above indicate moderate to severe depressive symptoms. The PHQ-9 has demonstrated strong reliability and validity in both clinical and community populations and is commonly used in rehabilitation research (Sun et al., 2020).

Data Analysis
Data were analysed using SPSS version 26.0. Data entry was double-checked against raw data to minimise errors, and data cleaning procedures were conducted before analysis. Descriptive statistics were used to summarise participant characteristics and outcome measures. Given the small sample size, non-parametric statistical methods were prioritised where appropriate. The Chi-square test was used to examine associations between gender and depression severity.

Spearman's rho correlation was employed to assess the relationship between shoulder pain and physical activity levels. Point-biserial correlation using Pearson's correlation coefficient was used to examine relationships between years since injury and depression severity, as well as years since injury and shoulder pain. All analyses were interpreted cautiously, recognising the study's exploratory nature and limited statistical power.

RESULTS

Participants Characteristics
Table 1: Sociodemographic and injury-related characteristics of the participants.

Participants (n=18)	characteristics	Mean (SD) or Number of Participants
Age		35.50
Male		12 (66.7%)
Race	Malay	16 (88.9%)
	Indian	2 (11.1%)
Marital status	Single	5 (27.8%)
	Married	11 (61.1%)
	Widowed	2 (11.1%)
Level of Injury	Paraplegia	15 (83.3%)
	Tetraplegia	3 (16.7%)
Years since injury		13.39
Amount of household income		3186.67 (1619.02)
Education Level	Primary	1 (5.6%)
	Secondary	6 (33.3%)
	Diploma	3 (16.7%)
	Degree	5 (27.8%)
	Master's	3 (16.7%)
Employment status	Employed	10 (55.6%)
	Self-employed	5 (27.8%)
	Unemployed	3 (16.7%)

A total of 18 individuals with SCI participated in this study, with a mean age of 35.50 years (SD = 6.06). The majority were male (66.7%) and of Malay ethnicity (88.9%), while 11.1% were Indian. Most participants were married (61.1%), whereas 27.8% were single and 11.1% widowed. In terms of injury characteristics, 83.3% of the sample had paraplegia and 16.7% had tetraplegia. The mean duration since injury was 13.39 years (SD = 8.36), indicating that most participants were in the chronic phase of SCI. The mean monthly household income was RM 3,186.67 (SD = 1,619.02). Educational attainment varied: 33.3% completed secondary school, 27.8% held a bachelor's degree, 16.7% held a diploma, 16.7% held a master's degree, and 5.6% had only primary-level education. In terms of employment status, more than half were employed (55.6%), while 27.8% were self-employed and 16.7% were unemployed (Table 1)

Physical Activity Levels, Pain and Depression
Table 2: The level of physical activity, pain and depression

Variable	Mean (SD)
Physical Activity Scale for Individuals with Physical Disabilities (PASIPD)	50.917(31.2806)
Wheelchair User's Shoulder Pain Index (WUSPI)	26.17 (21.399)
Patient Health Questionnaire (PHQ-9)	1.61 (0.916)

Physical activity levels, measured using the PASIPD, showed considerable variability among participants. The mean PASIPD score was 50.92 (SD = 31.28), indicating that although some participants engaged in relatively high levels of activity, others demonstrated much lower activity levels, reflecting diverse functional abilities and lifestyle patterns among community-dwelling adults with SCI in the Klang Valley (Table 2).

The mean WUSPI score was 26.17 (SD = 21.40), suggesting overall low to moderate shoulder pain severity in the sample. The large standard deviation indicates substantial variation between individuals, with some reporting minimal discomfort and others experiencing notable shoulder pain during wheelchair propulsion, transfers, and other upper-limb activities (Table 2).

Depressive symptoms, assessed using the PHQ-9, showed a mean score of 1.61 (SD = 0.92). This indicates that the majority of participants experienced minimal depressive symptoms. The relatively small variation in scores suggests consistent psychological well-being across the sample, with few participants reporting moderate or severe depressive experiences (Table 2).

Association Between Physical Activity and Shoulder Pain
Table 3. Associations between physical activity, shoulder pain, depressive symptoms, gender, and years since injury

Association	Statistical Test	Correlation Coefficient (r / ρ)	p-value	Interpretation
Physical activity (PASIPD) vs. Shoulder pain (WUSPI)	Spearman's rank correlation (ρ)	–0.030	0.904	No significant association; negligible negative relationship indicating largely independent variation between physical activity and shoulder pain
Physical activity (PASIPD) vs. Depressive symptoms (PHQ-9)	Spearman's rank correlation (ρ)	0.105	0.679	No significant association; negligible positive relationship with minimal practical relevance
Gender vs. Depression severity (PHQ-9 categories)	Chi-square test of independence	—	0.171	No significant association between gender and depression severity
Years since injury vs. Depressive symptoms (PHQ-9)	Pearson's correlation (r)	–0.105	0.677	No significant association; weak negative relationship suggesting minimal influence of injury duration on depressive symptoms
Years since injury vs. Shoulder pain (WUSPI)	Pearson's correlation (r)	0.279	0.263	No significant association; weak positive relationship indicating a non-systematic trend toward higher shoulder pain with longer injury duration

The relationship between physical activity levels and shoulder pain severity was examined using Spearman's correlation analysis. The correlation coefficient between PASIPD and WUSPI scores was –0.030, indicating a very weak negative relationship. This direction suggests that higher physical activity levels were minimally associated with lower shoulder pain severity; however, the magnitude of this association was negligible. The corresponding p-value (p = 0.904) indicated that the relationship was not statistically significant (Table 3). The very small rho value suggests that physical activity level and shoulder pain severity varied largely independently within this sample, with no clear monotonic trend observed. In practical terms, this indicates that participants with higher activity levels did not consistently report either

greater or lesser shoulder pain.

Association Between Physical Activity and Depression Severity

Spearman's correlation analysis between physical activity (PASIPD) and depressive symptoms (PHQ-9) yielded a correlation coefficient of 0.105, representing a very weak positive relationship. This direction suggests that higher physical activity levels were associated with slightly higher depressive symptom scores; however, the strength of the association was minimal. The relationship was not statistically significant (p = 0.679).

The weak magnitude of the correlation indicates that physical activity level was not meaningfully related to depression severity in this sample, and that depressive symptoms remained consistently low across participants regardless of activity level. This lack of a clear directional pattern suggests that other factors beyond physical activity may have a stronger influence on depressive symptoms among these community-dwelling individuals with SCI.

Association Between Gender and Depression Severity
Table 2 presents the distribution of depression severity by gender among the 18 participants. Among males, 9 (50.0%) reported minimal depression, 1 (5.6%) mild, 1 (5.6%) moderate, and 1 (5.6%) moderately severe depression. Among females, 2 (11.1%) reported minimal depression, 3 (16.7%) mild, 1 (5.6%) moderate, and none reported moderately severe depression. Overall, most participants demonstrated minimal depressive symptoms (61.1%), followed by mild (22.2%), moderate (11.1%), and moderately severe depression (5.6%). A Chi-Square test was conducted to examine the association between gender and depression severity. The result (p = 0.171) indicated that the association was not statistically significant. This suggests that depression severity did not differ meaningfully between males and females in this sample.

Association Between Years Since Injury and Depression

Pearson's correlation analysis examining the relationship between years since injury and depressive symptoms yielded a correlation coefficient of –0.105, indicating a weak negative relationship. This suggests that a longer duration since injury was minimally associated with lower depressive symptom severity, although the association was small and not statistically significant (p = 0.677). The weak negative direction may reflect a trend toward psychological adaptation over time, but the low magnitude of the correlation indicates that years since injury alone does not adequately explain variations in depressive symptoms within this sample.

Association Between Years Since Injury and Shoulder Pain

The relationship between years since injury and shoulder pain severity was also examined using Pearson's correlation. The correlation coefficient was 0.279, indicating a weak positive relationship. This suggests that a longer time since injury was associated with slightly higher shoulder pain severity, although the association did not reach statistical significance (p = 0.263).

While the direction of the association may reflect cumulative upper-limb loading over time, the weak strength of the relationship indicates that shoulder pain severity is likely influenced by multiple factors, such as wheelchair propulsion technique, activity patterns, and individual biomechanics, rather than injury duration alone.

DISCUSSION

This study examined the associations between physical activity, shoulder pain, and depressive symptoms among individuals with SCI residing in the Klang Valley. Contrary to expectations, no significant associations were identified between physical activity levels and either shoulder pain or depressive symptoms. Rather than diminishing the value of physical activity, these findings suggest that its role in shaping pain and mental health outcomes in SCI may be context-dependent and mediated by multiple interacting factors.

The absence of a significant association between physical activity and shoulder pain reinforces the understanding that shoulder pain in manual wheelchair users is not solely determined by overall activity volume. Recent international evidence increasingly conceptualises shoulder pain as a multidimensional condition influenced by propulsion biomechanics, wheelchair configuration, cumulative loading patterns, muscle imbalance, and psychosocial factors (Boninger et al., 2022). In this context, global physical activity measures such as PASIPD may not adequately capture the specific upper-limb stresses associated with wheelchair propulsion, transfers, and repetitive load-bearing tasks, which may explain the lack of observable association in the present study. Similar null or weak associations between activity volume and shoulder pain have been reported in other community-based SCI cohorts, particularly when task-specific propulsion metrics were not assessed (Mulroy et al., 2015; Dyson-Hudson et al., 2020).

Likewise, the absence of a significant relationship between physical activity and depressive symptoms suggests that psychological well-being following SCI may be shaped more strongly by contextual and psychosocial determinants than by activity level alone. International studies consistently highlight that depression in SCI is influenced by coping strategies, perceived autonomy, social participation, environmental

accessibility, and financial security rather than by physical activity per se (Craig et al., 2017; Post & van Leeuwen, 2019; Williams & Murray, 2015). In the Malaysian context, strong family support systems and community reliance may buffer psychological distress, potentially explaining why most participants reported minimal depressive symptoms despite long durations since injury. This interpretation is consistent with local findings indicating that environmental and social determinants play a dominant role in shaping mental health outcomes among Malaysians with SCI (Zainudin et al., 2025).

Gender was not significantly associated with depression severity in this study. While several international cohorts have reported higher rates of depressive symptoms among women with SCI, often attributed to gendered caregiving expectations or differential pain coping strategies (Bombardier et al., 2016), such differences were not evident in the present sample. This may reflect cultural norms in Malaysia where caregiving and emotional support are typically distributed across family networks regardless of gender, as well as the limited statistical power of the current study to detect subtle subgroup differences.

Similarly, no significant associations were observed between years since injury and either depressive symptoms or shoulder pain severity. These findings challenge linear assumptions that longer injury duration inevitably leads to either adaptation or deterioration, and instead support international literature suggesting that long-term outcomes in SCI are shaped more by current life circumstances than by time since injury alone (Middleton et al., 2014). Recent global evidence further suggests that chronic shoulder pain often reflects persistent biomechanical inefficiencies and compensatory movement strategies that may stabilise over time rather than progress linearly (Palmer, 2024), which may explain the weak associations observed in this cohort.

Environmental context may also help explain the overall pattern of null findings. In Western settings, where wheelchair users often engage in prolonged propulsion over long distances, international studies have reported modest associations between activity exposure and upper-limb pain (Boninger et al., 2012; van der Woude et al., 2016). In contrast, the dense urban environment of the Klang Valley, characterised by uneven pavements, limited accessibility, traffic congestion, and reliance on motorised transport, may restrict sustained wheelchair propulsion, thereby reducing cumulative shoulder loading. At the same time, these environmental barriers may contribute to psychosocial stressors that overshadow any potential mental health benefits of physical activity, helping to explain the weak association between activity levels and depressive symptoms.

Taken together, these findings suggest that shoulder pain and psychological well-being among community-dwelling adults with SCI in the Klang Valley are influenced by a complex interplay of biomechanical, environmental, and social factors rather than by physical activity levels alone. Rather than highlighting the primacy of physical activity, the results underscore the need to examine how activity interacts with propulsion technique, wheelchair ergonomics, environmental accessibility, and social support systems. Accordingly, rehabilitation strategies may benefit from prioritising shoulder preservation programmes, propulsion efficiency training, ergonomic wheelchair configuration, and improvements in community accessibility, alongside efforts to promote physical activity.

Future research should employ larger, adequately powered samples and longitudinal designs, incorporate task-specific activity measures, and examine potential confounders and moderators, such as wheelchair skills, environmental exposure, pain-coping strategies, and social participation. Such approaches are essential to clarify how physical activity contributes to pain and mental health outcomes across diverse sociocultural and environmental contexts, including urban Malaysian settings.

IMPLICATIONS FOR PRACTICE

These findings carry important implications for clinical practice, policymakers, researchers, and key stakeholders within the Klang Valley. In this highly urbanised and fast-paced region, individuals with SCI face unique accessibility challenges, including limited wheelchair-friendly infrastructure, crowded environments, and transportation barriers. Clinicians should therefore prioritise tailored physical activity interventions that specifically address shoulder pain, psychological well-being, and the practical realities of living in a busy metropolitan setting. Regular monitoring and individualised progression of exercise programs are essential to maintain long-term participation. For policymakers, the results highlight the need to strengthen urban accessibility, invest in community-based rehabilitation, and integrate mental health screening into standard SCI care pathways. Improving barrier-free access to exercise facilities, parks, and public transport in the Klang Valley can significantly enhance opportunities for physical activity. From a research perspective, the small community-based sample underscores the difficulty of reaching individuals with SCI in busy cities, where accessibility and mobility challenges often limit participation. Larger, multi-centre or nationwide studies are needed to validate these findings and explore long-term effects. This requires strong support from stakeholders, including government agencies, healthcare organisations, NGOs, and industry partners, particularly through increased funding to expand recruitment, enhance community outreach, and develop sustainable SCI rehabilitation programs.

LIMITATION

Several methodological limitations related to recruitment and study design should be acknowledged. Participants were recruited using a non-probability snowball sampling approach, which was appropriate for accessing a hard-to-reach population such as community-dwelling adults with SCI, but may have introduced selection bias. Individuals who were more socially connected, engaged with rehabilitation services, or more willing to participate in research may have been overrepresented. In addition, the small sample size limited statistical power, reducing the ability to detect subtle associations between physical activity, shoulder pain, and depressive symptoms. The cross-sectional design further restricts interpretation, as temporal or causal relationships between variables cannot be established. These factors suggest that the findings should be interpreted cautiously and viewed as exploratory.

Contextual and cultural factors specific to the Klang Valley may also limit the generalisability of the findings. Malaysia's collectivist cultural norms, characterised by strong family involvement and shared caregiving responsibilities, may buffer psychological distress among individuals with SCI, potentially attenuating observable relationships between physical activity and depressive symptoms. Furthermore, the dense urban environment of the Klang Valley, marked by uneven pavements, limited wheelchair accessibility, traffic congestion, and reliance on motorised transport, may restrict sustained wheelchair propulsion and reduce cumulative upper-limb loading. These environmental constraints may obscure potential relationships between physical activity volume and shoulder pain, limiting the applicability of the findings to settings with different cultural or infrastructural characteristics.

CONCLUSION

In conclusion, this exploratory study found no significant associations between physical activity levels and shoulder pain or depressive symptoms among individuals with SCI residing in the Klang Valley. These findings should be interpreted cautiously, given the small sample size and cross-sectional design, and they suggest that pain and psychological well-being in this population may be influenced by a broader range of biomechanical, environmental, and psychosocial factors rather than physical activity alone. The absence of significant relationships highlights the need for future research using larger, adequately powered samples, longitudinal designs, and task-specific measures to better understand how physical activity interacts with contextual and individual factors in shaping pain and mental health outcomes among people with SCI

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