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Original article

Prevalence of musculoskeletal disorders and their association with work-related stress, muscle flexibility and physical activity level among police officers in Kandy police division, Sri Lanka

H M T M Premarathne[1*], L A S Perera[1], M R Wijesuriya[1], A M Alphons[1], S Yogarajah[1], Z M Zamhi[1], L P P C Liyanapathirana[1], M M J P Manchanayake[1], E Liyanage[1]

*Correspondence: tharindipremarathne@ahs.pdn.ac.lk https://orcid.org/0009-0002-4424-2039

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ABSTRACT

Background & Aim: Musculoskeletal disorders (MSDs) are prevalent among police officers due to the physical and psychological demands of their work. Factors such as work-related stress, inadequate flexibility and low physical activity levels may contribute to MSDs. This study aimed to determine the prevalence of MSDs among police officers in Kandy police division, Sri Lanka and to investigate the associations between MSDs and work-related stress, muscle flexibility and physical activity level.

Methods: A descriptive cross-sectional study was conducted among 462 police officers in the Kandy police division, Sri Lanka. The Nordic Musculoskeletal Questionnaire (NMQ) was used to assess prevalence of MSDs. Work-related stress was measured using the Operational Police Stress Questionnaire (PSQ-Op). Physical activity levels were evaluated using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) and flexibility was assessed using the Shoulder Stretch Test and Sit and Reach Test.

Results: In this study, the prevalence of MSDs was 78.8%, with lower back (48.5%) and knee (41.1%) being most affected. Regarding physical activity levels, 50.2% police officers were inactive. Stress levels were significantly high (64.1%). Chi-square analysis revealed significant associations between prevalence of MSDs and stress (χ^2=15.93, p<0.01), physical inactivity (χ^2=6.54, p<0.05), poor flexibility in upper extremity on the right (χ^2=7.21, p<0.05) and lower extremity (χ^2=13.16, p<0.05). There was no statistically significant association between prevalence of MSDs and flexibility in upper extremity on the left side (χ^2=4.16, p>0.05).

Conclusions & Recommendations: The study demonstrated a significant prevalence of MSDs, with significant associations between MSDs and work-related stress, reduced physical activity and reduced muscle flexibility. These findings highlight the need for targeted interventions, such as stress management, flexibility training and promoting regular physical activity to improve the overall health and well-being of police officers.

Keywords: *musculoskeletal disorders, police officers, work-related stress, muscle flexibility, physical activity level, prevalence*

Introduction

Musculoskeletal disorders (MSDs) comprise a broad range of disorders affecting joints, ligaments, muscles, nerves, tendons and supporting blood vessels of limbs, neck and back (1). MSDs comprise a plethora of different disorders affecting the locomotor system. Importantly, they are associated with significant morbidity and disability, impacting the quality of life. These include clinical syndromes such as tendon inflammations and related conditions, nerve compression disorders, and osteoarthrosis, as well as conditions such as myalgia, low back pain and other regional pain syndromes not attributable to known pathology. Body regions commonly involved are the low back, neck, shoulder, forearm, and hand, although recently the lower extremity has received more attention (2,3). MSDs are major causes of pain disability absenteeism, reduced productivity and heavy financial cost among workers worldwide (1,4).

Globally, numerous studies have investigated the prevalence and risk factors of MSDs among police officers. (5). According to a study conducted in India, neck pain was the most prevalent musculoskeletal complaint (51%), followed by lower back pain (45%) (1). A study conducted in Nigeria reported an overall prevalence of musculoskeletal disorders (MSDs) of 81% among police officers. The lower back was the most affected body region (74.1%), followed by the neck (48.3%) and the elbow (9.8%). The lower back was also the leading cause of activity limitation (9.8%), followed by the neck (6.8%) and the elbow (2.1%). Higher prevalence of MSDs was observed among officers who worked 24-hour shifts (80.5%), had less than 10 years of work experience (76.2%), and were overweight (86.1%) (6). Some studies identified the lumbar, neck and shoulder as the most affected regions (7,8), while lower back problems were more than about 70% in some law enforcement populations, exposed to prolonged sitting, heavy duty equipment and long service years (9).

In Sri Lanka, a survey investigated the prevalence of musculoskeletal complaints and associated risk factors among nurses, postal workers, sewing machinists, and computer operators. The study found that the lower back was the most commonly affected site, followed by the shoulder, while wrist and hand pain were reported relatively infrequently. (10).

Several factors are involved in the aetiology of MSDs. Excessive repetitions, awkward posture and heavy lifting are major biomechanical risk factors of MSDs. Other factors such as physical activity level, psychosocial factors (stress) and absence of ergonomics viability may be linked with MSDs symptoms and prevalence (1). Chronic exposure to stress and traumatic events can lead to changes in posture, muscle tension, and other physical symptoms, which can contribute to the development of low back pain. Poor ergonomic conditions, such as the use of heavy equipment and awkward postures, can exacerbate the effects of psychosocial stress and increase the risk of MSDs. Working in the same position for a long period is the most common risk factor, while working in awkward or cramped position, is the second most common risk factor of MSDs. The least risk factor commonly identified was carrying, lifting, or moving heavy materials (e.g., bulletproof vest, gun, etc.) (6,11). The activities commonly performed by most police officers require that they remain in uncomfortable static or repetitive positions, such as sitting in police vehicles, as well as using personal protective equipment such as duty belts, weapons and ballistic vest which generate high physical overload that could put them at risk of developing musculoskeletal symptoms (5). Psycho-social work factors are specified as distraction elements of the work environment factors and play a major role in the development of MSDs (12,13). In previous studies on traffic police motorcycle riders (14), it

was found that a well-designed vehicle seat is supported by the backrest, the muscles relax, and the lumbar spine is supported. Meanwhile, a poorly designed vehicle seat may promote a slouched sitting posture due to inadequate activation of the trunk muscles, resulting in a loss of lumbar lordosis and an increase in thoracic kyphosis. (15).

Flexibility is a physiological characteristic that allows an individual to execute voluntary movements of maximum joint angular amplitude within morphological limits, free of pain and restrictions. When there is a limitation in movement, the body undergoes several counterbalances, to establish an adaptive response to a set of disharmonies, which may influence the adopted posture (16,17). Flexibility plays a crucial role in preventing injuries and enhancing performance, especially in physically demanding occupations such as policing. Examining the correlation between flexibility levels and MSDs can provide insights into the importance of incorporating flexibility training into police officers' training routine. Proper biomechanics, facilitated by flexibility, can enhance energy efficiency during physical activities, reducing the physical strain experienced during work tasks. Also, poor flexibility can lead to muscular imbalances, restricted ROM, and increased susceptibility to injuries (18).

Physical activity, which is closely related to MSDs is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. The role of physical activity in the prevention and treatment of diseases has been recognized (19) and often recommended for preventing several diseases, including MSDs (20).

Work-related stress is defined as a harmful reaction that people must withstand undue pressures and demands placed on them at work (21). Workplace stress occurs in the workplace or work-related organization and is a harmful mental and physical reaction coming from discordance between employee's ability, resources, willingness and work requirement (21,22). Police officers are often required to perform under high-stress circumstances, where they particularly experience anxiety, increased cortisol levels and increased cardiac vagal activities (23).

The literature indicates that MSDs are a prevalent issue among police officers, with work-related stress and physical activity levels are being significant factors. This study provides valuable insights into the prevalence of MSDs among police officers in Kandy police division, Sri Lanka.

According to the differences in lifestyles of people, MSDs also show a wide variation. Identifying the association between MSDs, work-related stress, muscle flexibility and physical activity level among police officers may help improve rehabilitation outcomes and inform the development of effective injury prevention strategies.. The current study aimed to assess the association between MSDs, work-related stress, muscle flexibility and physical activity level among police officers in Kandy police division, Sri Lanka.

Methods

Study design and participants

The study was conducted in police stations in Kandy police division, Sri Lanka. The study population comprised police officers in Kandy police division, Sri Lanka. Both male and female officers, aged 18 to 60 years, who had at least one year of work experience. Exclusion criteria included officers with a history of trauma to the spine, fractures, neurological, cardiovascular and psychological disorders and or a diagnosis of local and systemic infection or malignancies within past 12 months.

Ethical consideration

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka (AHS/ERC/2024/044). Permission was obtained

from the senior superintendent of police in Kandy police division.

Data collection

Cluster random sampling was used to select the police stations from Kandy police division, Sri Lanka, which comprised 17 police stations. According to data provided by the Senior Superintendent of Police of the Kandy Police Division, the number of police officers per station ranged from 7 to 293.

The required sample size was calculated as 417 with using a prevalence estimate (p) = 0.5, a margin of error (E) = 0.05, 95% level of confidence (Z) = 1.96, and design effect (D) = 1.524. Considering the required sample size of 417 and the distribution of police officers across stations (7–293 officers per station), 15 police stations were selected using a computer-generated random number sequence. .

Data collection commenced following the numerical order obtained from the computer-generated random sequence. This procedure was continued systematically until the required sample size was achieved. Within each randomly selected police station, individuals who met the established inclusion and exclusion criteria were recruited for participation in the study. Prior to data collection, permission was obtained from the officer in charge of each selected police station. At the completion of data collection in the 11th police station the required sample size was reached. Thus, data collection procedure was stopped with this police station.

Data collection began after obtaining written informed consent from participants. Officers were given information sheets and were asked to fill out the socio-demographic data forms and questionnaires regarding MSDs, work-related stress, and physical activity. Muscle flexibility was assessed with the shoulder stretch test for upper body flexibility and the sit and reach test for lower body flexibility. Each test was repeated three times, with the average score taken as the final.

Data collection tools

Nordic Musculoskeletal Questionnaire (NMQ)

Nordic Musculoskeletal Questionnaire (NMQ) is open access instrument that is freely available for use. The questionnaire was completed with the aid of a body map illustrating nine anatomical regions (neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs, knees, and ankles/feet). Subjects were asked to complete the questionnaire if they had experienced any musculoskeletal trouble in the last 12 months or the last seven days that had prevented them from participating in normal day-to-day activities (25). This questionnaire was translated into Sinhala and Tamil languages, and it was pretested among 50 police officers who were working in Kandy police division.

Operational Police Stress Questionnaire (PSQ-Op)

Operational Police Stress Questionnaire (PSQ-Op), open access and free to use, assessed operational stress using a 7-point scale (26). The cut-off points for interpreting the scores were as follows: low stress (scores less than or equal to 2.0), moderate stress (scores between 2.1 - 3.4), and high stress (scores greater than or equal to 3.5). This questionnaire was translated into Sinhala and Tamil languages, and it was pretested among 50 police officers who were working in Kandy police division, Sri Lanka.

International Physical Activity Questionnaire-Short Form (IPAQ-SF)

International Physical Activity Questionnaire-Short Form (IPAQ-SF) is open access instrument that is freely available for use. It evaluated physical activity levels over the last seven days. It covered activities such as walking, moderate-intensity activities and vigorous-intensity activities, as well as time spent sitting to estimate total physical

activity in metabolic equivalent Tasks (MET)-minutes per week. The questionnaire provides a scoring system based on MET-minutes per week, calculated by multiplying the MET value for each activity by the minutes performed per week, summed across all activities (27). The questionnaire had already been pretested in Sinhala and Tamil languages, and these versions of the IPAQ-SF were used in the study (28).

Shoulder stretch test

Shoulder stretch test was used to measure upper body flexibility, and this test assessed the general shoulder range of motion (ROM) by how close the hands could be brought together behind the back. It demonstrates moderate to high reliability, with intra and inter-rater reliability coefficients ranging from 0.94 to 0.98, in healthy adults (29).

Participants were provided with standardized verbal instructions, and the testing procedure was demonstrated before assessment. The test was preceded by a three-minute upper-limb warm-up comprising range-of-motion exercises and gentle stretching. Participants were asked to hold the position for five seconds and distance between the tips of the middle fingers was measured. One practice attempt was given, and the average distance of three attempts for each hand was calculated as the final score. The average score was recorded to the nearest centimetre. If both fingers touched, the score was recorded as zero. If they did not touch, the distance between the fingers was measured and recorded as a negative score. If the fingers overlapped, the distance was recorded as a positive score (30). Results were interpreted as Good, Fair and Poor. (Good - fingers were touching, Fair - fingertips were not touching but were less than two inches (5cm) apart, Poor - fingertips were greater than two inches (5cm) apart.

Sit and reach test

Sit and reach test was used to measure lower body flexibility. This test has demonstrated moderate criterion-related validity, with correlation coefficients ranging from 0.46 to 0.67. When administered under standardized conditions, it also shows high test-retest reliability, making it a dependable tool for tracking flexibility over time (31,32). Participants performed a warm-up session prior to the test with gentle stretches. They were advised not to make fast, jerky movements that could increase the risk of injury. Participants were asked to remove their shoes and sit on the exercise mat with their legs stretched out. After few practice-reaches, the Participants was asked to reach out and hold that position for at least 1-2 seconds while the distance was recorded. The score was recorded to the nearest centimetre as the distance reached by the hand. Three attempts were given, and the average was calculated and considered as the final score (33).

Statistical analysis

Data were analysed using SPSS software (version 22). Descriptive statistics, mean and standard deviation were used to summarize socio-demographic information. The prevalence of MSDs was presented as percentages per body region. Chi-square tests were used to determine associations between MSDs, work-related stress, muscle flexibility and physical activity levels.

Results

Socio-demographic characteristics of participants

Socio-demographic characteristics of the study participants, such as age, service years and Body Mass Index (BMI) by gender, are presented in Table 1.

Prevalence of MSDs and impact on work interference

The prevalence of MSDs and their impact on work interference by body region are presented in Table 2. The highest prevalence was observed in the lower

back (48.5%) followed by the knee (41.1%). The shoulder (32.9%) and the neck (28.6%) were also frequently affected. The ankle and foot (26.8%) and hip and thigh (14.5%) had a moderate level of reported pain. The elbow (14.3%), upper back (13%), and wrist and hand (18.4%) showed lower rates of reported pain.

Table 1. Socio-demographic characteristics of participants

Variable	Male (n=322) Mean (SD)	Female (n=140) Mean (SD)
Age (years)	46.9 (10.06)	41.2 (9.46)
Service years	24.8 (10.26)	18.3 (9.42)
BMI (kg/m²)	24.8 (3.89)	24.4 (4.42)

BMI: body mass index

Data are presented as mean and standard deviation (SD)

Table 2. Prevalence of MSDs and its work interference by body region

Area of the body affected	SL 12 months No. (%)	PNAL 12 months No. (%)	SL 7 days No. (%)
Neck	132 (28.6%)	84 (18.2%)	72 (15.6%)
Shoulder	152 (32.9%)	102 (22.1%)	77 (16.7%)
Elbow	66 (14.3%)	43 (9.3%)	40 (8.7%)
Wrist and hand	85 (18.4%)	55 (11.9%)	37 (8.0%)
Upper back	60 (13.0%)	60 (13.0%)	57 (12.3%)
Lower back	224 (48.5%)	146 (31.6%)	112 (24.2%)
Hip and thigh	67 (14.5%)	39 (8.4%)	32 (6.9%)
Knee	190 (41.1%)	115 (24.9%)	99 (21.4%)
Ankle and foot	124 (26.8%)	83 (18.0%)	70 (15.2%)

SL 12: Symptoms in Last 12 months, PNAL: Prevent Normal Activity in Last 12 months, SL 7: Symptoms in Last 7 days

Data are presented as frequency (n) and percentages (%)

Table 3. Overview of work-related stress, flexibility and physical activity level

Area of the body affected	Total (n)	Minimum	Maximum	Mean	SD
WRS	462	1.00	7.0	3.76	1.19
SST Left (cm)	462	0.00	56.0	8.31	9.13
SST Right(cm)	462	0.00	41.0	7.61	9.20
SRT (inches)	462	0.00	23.0	13.05	3.98
PAL (MET minutes per week)	462	0.00	9252	1189.09	1521.14

SD: standard deviation, WRS: work-related stress, SST: shoulder stretch test, SRT: sit and reach test, PAL: physical activity level, MET: metabolic equivalent of task

Data are presented as frequency (n) and percentages (%)

The individuals with musculoskeletal symptoms in any body region within the last 12 months were 364 (78.8%). During the same period of last 12 months, 51.5% experienced symptoms that prevented normal activities. In the last 7 days, 38.5% were had symptoms presented in one or more of the affected body regions.

Scores for work-related stress, flexibility and physical activity levels

The results of work-related stress, upper body flexibility, lower body flexibility and physical activity levels are presented in Table 3.

The mean physical activity level of the participants was 1189.09 (SD=1521.14) MET minutes per week. Regarding physical activity levels, 50.2% were inactive, while 34.2% and 15.6% were minimally active and Health Enhancing Physical Activity (HEPA) active respectively. The work-related stress ranged from 1.00 to 7.0, with a mean (SD) of 3.76 (1.19). Among total participants, 64.1%, 27.5% and 8.4% showed high, moderate and low stress, respectively. Upper extremity flexibility on the left side was measured, yielding a mean (SD) value of 8.31 (9.13) cm, while upper extremity flexibility on the right side was 7.61 (SD=9.20) cm. Good, fair and poor percentages for upper extremity flexibility on the left side were 36.1%, 11.3%, 52.6% and on the right side it was 40.3%, 12.1%, 47.6%. Lower extremity flexibility had a mean (SD) score of 13.05 (3.98) inches. 1.7% were in the well above average category, while 13.6%, 23.4%, 43.3% and 18% were in the above average, average, below average and well below average categories.

Prevalence of MSDs according to each variable are presented in Table 4.

Table 4. Prevalence of MSDs according to each variable

Variable		MSD Prevalence	
		No.	(%)
Work-related stress	High stress	248	68.1
	Moderate stress	93	25.5
	Low stress	23	6.3
Physical activity level	HEPA active	57	15.6
	Minimally active	153	42
	Inactive	154	42.4
Upper body flexibility (L)	Good	123	33.8
	Fair	42	11.5
	Poor	199	54.7
Upper body flexibility (R)	Good	135	37.1
	Fair	46	12.6
	Poor	183	50.3
Lower body flexibility	Well above average	5	1.4
	Above average	43	11.8
	Average	78	21.4
	Below average	167	45.9
	Well below average	71	19.5

MSD: musculoskeletal disorders, HEPA: Health Enhancing Physical Activity
Data are presented as frequency (n) and percentages (%)

Table 5. Overview of work-related stress, flexibility and physical activity level

Variable	Pearson Chi-square Value	Degree of freedom	*p* value
PAL	6.54	2	0.04*
UBF (L)	4.16	2	0.13
UBF (R)	7.21	2	0.03*
LBF	13.16	4	0.01*
WRS	15.93	2	0.01*

PAL: physical activity level, UBF: upper body flexibility, LBF: lower body flexibility, WRS: work-related stress
**Statistically significant at p<0.05*

The results of the Chi-square test for the association between prevalence of MSDs and physical activity level, muscle flexibility for upper body and lower body and work-related stress are presented in Table 5. Physical activity level had a significant association with MSDs (p = 0.04). While left-side upper body flexibility did not show a significant association (p = 0.13), right-side flexibility was significant (p = 0.03). Lower body flexibility and work-related stress both showed significant associations with MSDs, with p-values = 0.01.

Discussion

The high prevalence of MSDs among police officers in Kandy police division, Sri Lanka, particularly in the lower back (48.5%) and knee (41.1%), is consistent with existing literature. Research conducted among police officers in Brazil, Canada and the United Kingdom have similarly reported lower back pain as the most common musculoskeletal complaint among police officers (8). The lower back and knee are particularly vulnerable regions in police work due to the physical demands associated with prolonged standing, walking and heavy lifting, which may contribute to the increased occurrence of MSDs in these body regions (7).

Further, the shoulder (32.9%) and neck (28.6%) were also frequently reported as affected areas in this study. The physical demands of police work, including the need to carry heavy equipment, manage arrests or engage in physical altercations, can exacerbate stress on these regions. Repetitive, strenuous tasks can lead to muscle strain and postural issues, particularly in the upper body (3). The moderate prevalence of complaints in other areas, such as the hip (14.5%) and ankle (26.8%), further supports the perception that police officers experience a broad range of musculoskeletal challenges due to the physically demanding nature of their work.

The results showed that inactive police officers had a higher prevalence of MSDs (42.4%) compared to minimally active (42%) and HEPA active (15.6%) police officers. This finding aligns with research conducted by Mynarski et al. (19), who reported that police officers who engage in regular physical training have lower rates of musculoskeletal pain and injury. Physical activity may help to strengthen muscles, improve flexibility and enhance joint stability, which may collectively reduce the risk of developing MSDs (8,9). However, the fact that a significant proportion of police officers (50.2%) were identified as inactive points towards a need for health and wellness interventions within the police force. Inactive police officers may be more susceptible to muscle imbalances, joint stiffness and an overall reduction in physical resilience, which in turn increases their risk for MSDs (20).

Findings show that there was a significant association between work-related stress and the prevalence of MSDs. Most police officers (68.1%) reported high stress levels, and these police officers

experienced a substantially higher prevalence of MSDs, particularly in the lower back and shoulders.

Chronic stress has been shown to contribute to increased muscle tension, particularly in areas such as the neck, shoulders and lower back. Police officers are regularly exposed to high-stress situations, including emergency responses, potential physical confrontations and the psychological aspect of working with vulnerable populations. These stressors can negatively impact both mental and physical health, leading to muscle tightness, chronic pain and increased susceptibility to injury (21).

The study also examined the relationship between muscle flexibility and MSDs prevalence for upper body and lower body separately. Police officers with below-average lower body flexibility were more likely to report MSDs, particularly in the lower back. Also, police officers with poor upper body flexibility on the left side and on the right-side reported a higher prevalence of MSDs. Police officers with limited flexibility may experience restricted range of motion (ROM) and muscular imbalances, which can lead to strain and injury (9). The results also revealed that a majority of police officers (52.6%) on the left shoulder stretch test and 47.6% on the right shoulder stretch test exhibited poor flexibility, indicating that reduced shoulder flexibility is a common concern within this population.

In summary, the findings of this highlights the significant prevalence of MSDs among police officers in Kandy police division and underscore the importance of physical activity level, stress management and flexibility training in preventing and managing these disorders.

This study's reliance on self-reported data for MSD symptoms, physical activity levels and stress introduces potential recall and social desirability biases, which may compromise the accuracy of the findings. Additionally, the cross-sectional design limits causal inference, as it captures associations without establishing directionality, it remains unclear whether stress contributes to the development of MSDs or if existing MSDs exacerbate stress levels. Moreover, the absence of controls for confounding factors such as socioeconomic status, access to healthcare, and pre-existing health conditions could influence the observed relationships between MSDs and variables like stress or physical activity. This study used only chi-square test, but there are several possible confounding factors such as age, gender, BMI, service years, duty type etc. A logistic regression analysis would be more suitable to examine independent associations with MSDs.

Future research on MSDs among police personnel in Sri Lanka should consider expanding the sample size and geographic scope, thereby enhancing the generalizability of findings. Adopting a longitudinal study design would allow for tracking the progression of MSDs over time and examining their relationship with work-related stress, physical activity levels and flexibility, thus providing stronger evidence for causation. To improve data accuracy and minimise biases inherent in self-reported measures, future studies should incorporate objective assessments. Evaluating the effectiveness of targeted interventions such as flexibility exercises and stress management programmes could further inform health policy and guide the development of evidence-based occupational health strategies for law enforcement personnel.

Conclusions

This study revealed a high prevalence of MSDs among police officers in Kandy police division, Sri Lanka, with lower back and knee being particularly prevalent. Findings suggest significant associations between MSDs and work-related stress, upper body right-side muscle flexibility, lower body muscle flexibility and physical activity level. Inactive police officers, those experiencing high stress, and those with limited muscle flexibility showed a higher prevalence of MSDs.

The study affirms the importance of targeted

interventions in physical activity level, flexibility training and stress management, to reduce MSDs prevalence and enhance physical resilience among police officers.

Author Affiliations

[1]Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

Author Declarations

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