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Work-related musculoskeletal disorders among Pakistani laparoscopic and general surgeons

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Abstract

Background Healthcare care professionals, particularly surgeons, are at significant risk of acquiring work-related musculoskeletal disorders that can lead to prolonged pain and diminish productivity. This study aimed to identify the prevalence, associated risk factors, and coping strategies for work-related musculoskeletal disorders among general and laparoscopic surgeons in Pakistan.

Methods A cross-sectional survey was conducted to collect data from general and laparoscopic surgeons working in selected tertiary care hospitals located in Sialkot, Pakistan. The self-structured questionnaire consisted of four sections, including demographic information, musculoskeletal risk factors, work posture assessment and coping strategies. Logistic regression was used to determine associations between musculoskeletal disorders and personal and working factors, including postural demands during general and laparoscopic surgery using SPSS software 25.

Results Out of 171, 76% of the general surgeons and 86% of the laparoscopic surgeons reported suffering from WRMSDs within 1 year, and the 7-day prevalence was 24.5%. A total of 47.4% of the participants were also found to be at high risk or above, according to REBA scoring. Age, lifestyle, working hours, and number of surgeries performed per week were found to be significant (p value < 0.05) risk factors for WRMSDs. Assortment of coping strategies was employed, with changes in table/plinth height reported by 91.2% of the participants.

Conclusion The current study revealed that surgeons have a high prevalence of developing WRMSDs. Personal factors as well as work-related risk factors were found to be significant in the development of WRMSDs. General and laparoscopic surgeons exhibited different incidences of pain among body regions. Varying degrees of coping strategies were employed, with changing table/plinth height being the most common.

Keywords Work-related musculoskeletal disorders, Prevalence, Risk factors, Coping strategies, Surgeons

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Introduction

Musculoskeletal disorders (MSDs) can be defined as any impairment, inflammation or degenerative disease of the musculoskeletal system comprising bones, joints, muscles and connective tissues. These conditions can lead to pain, loss of sensation and/or loss of function in some parts of the body or throughout the body [1]. Globally, MSDs are one of the most debilitating conditions and are a major health and safety risk [2]. In the United States, MSDs are considered one of the most disabling and costly conditions [3]. Among professionals, WRMSDs are a major issue in both developing and developed countries [2]. It is estimated that WRMSDs may be more prevalent in developing or lower socioeconomic level countries. The prevalence of WRMSDs has been studied in many developed countries, such as the United States, the UK and members of the European Union. Studies conducted in developing countries such as India, Iran and Bangladesh have reported high levels of prevalence among health care professionals. This may be attributed to lower levels of knowledge about ergonomics, as well as a lack of good posture training and proper equipment [4].

Work-related musculoskeletal disorders (WRMSDs) are currently the leading cause of concern in the workplace. Work-related musculoskeletal disorders are conditions characterized by the following: [1] occupational or work routines that directly influence the appearance of conditions and [2] continuing work posing a significant risk to the condition and its severity [5]. WRMSDs contribute to absenteeism and early retirement and are costly for the organization and its efficiency [5, 6]. Thus, WRMSDs are considered to be the leading cause of Absentees in all member states of the European Union [7]. Work-related musculoskeletal symptoms (WRMSDs) are a major health issue in many occupations worldwide [6]. High rates of WRMSDs have been reported among health care professionals, with almost 68% of the workers having musculoskeletal disorders [8].

Surgeons are at higher risk for developing work-related musculoskeletal disorders, even among health care workers. The prevalence of neck pain among surgeons is as high as 80% [9]. According to a systematic review, a prevalence as high as 69% was reported by surgeons and interventionists [10]. However, one study reported that, in the case of surgery, work-related musculoskeletal symptoms may occur in any region of the body, with common complaints reported in the lower back (75%), neck (56%), upper back and shoulders (46%) [3].

The performance of surgery and its effects are heavily influenced by the approach used by surgeons. The surgical approach heavily influences everything from the surgeon's posture and length of the procedure to the development of associated musculoskeletal signs and symptoms. A 'general or open' approach is more common in the surgical setting. Open procedures typically involve prolonged static postures involving the whole body with sustained pressure on the neck to be flexed and rounding of the shoulders and upper back relative to the height of the operating table. In open procedures, surgeons may adopt more sustained lumbar flexion because the procedure involves working on deeper internal organs [11].

A paradigm shift has been observed in which preference has moved away from general procedures for both surgeons and patients. Advancements in medicine and equipment have facilitated the shift towards 'Minimally invasive or Laparoscopic' procedures. Patients have been shown to experience lower degrees of postoperative pain, shorter hospital stays, and better cosmetic results [12]. However, these procedures have a negative effect on the health of surgeons. Surgeons involved in such procedures experience heavier surgical burdens due to longer surgery times and the use of demanding postures and complicated equipment. Previous studies conducted by Berguer et al. [11] have shown that laparoscopic surgery is significantly more stressful than open surgery in terms of physical demands. The risk of developing MSDs in surgeons is further increased due to longer hours of work maintaining static postures and the requirement of performing highly coordinated fine hand movements. Laparoscopic surgery and its use of laparoscopic instruments have also been associated with a high frequency of injuries involving the wrist and hands [13].

Sustained static postures appear to be common among surgeons practicing in different fields where stress develops among regions held in a sustained/static or awkward position. Studies also suggest that posture during surgery is a determining factor for the prevalence of pain among surgeons [14]. It is widely agreed that when a neutral position and posture are held while performing their duties, the muscles are relaxed, which reduces the level of stress placed on the body [15]. This may only be possible if the basic principles of ergonomics are followed. A lack of ergonomic awareness and education contributes to a higher risk of developing WRMSDs among surgeons [16].

As most surgeons are already aware of the problems being faced, they may employ certain coping strategies inside and outside of the operating theatre to counteract the stressful situations that lead to the development of work-related musculoskeletal discomfort. These coping strategies may range from warm up exercises, short breaks and postural adjustment during surgery to lowering the frequency of surgeries per week and/or taking days of absence to recover from symptoms [17]. Positive coping strategies have been linked to lower levels of stress, as well as better end product assessment (EPA) [18]. An observable lack of research performed under similar conditions, especially in the city of Sialkot,

highlights the need for more research to bridge the gaps in the literature and raise awareness among those at high risk within the target population. The aim of this study was to assess the prevalence of work-related musculoskeletal disorders in Pakistani general and laparoscopic surgeons, which has rarely been documented in previous studies.

Methods

Participant recruitment

This cross-sectional study took place from 2nd October 2022 to 10th April 2023 and data were collected from selected tertiary care hospitals located in the city of Sialkot, Pakistan. All available and practicing general and laparoscopic surgeons within the city of Sialkot were included based on the inclusion criteria. Purposive sampling was employed to approach and enlist the surgeons from the target setting. The sample size was estimated, with a 95% confidence interval and 5% absolute error (d), using Open Epi software with a design effect of 1; the derived sample size was 171.

Participants of both genders with at least one year of experience in the field of surgery, surgeons specializing as general and/or laparoscopic surgeons, surgeons currently available and practicing within the city of Sialkot and surgeons who volunteered to participate in the study for their own free will were included in this study. Surgeons who had a history of trauma or musculoskeletal injuries. Patients with radiculopathy, myelopathy, or other disabilities were excluded.

Ethical considerations and informed consent

The study was approved by Ethical Research Committee of Riphah International University. Prior permission was obtained from the concerned authorities when data were collected from medical institutions, and written informed consent was obtained from all the participants who were informed about the purpose of the research and their right to privacy and confidentiality. The anonymity of the participants and the confidentiality of the data were maintained. All surgeons were approached individually and enrolled in the study by providing signed consent.

Data collection tool

The data were collected using a self-structured questionnaire based on a previous study [19] and included the following four parts [1]. The first part included demographic information that was further divided into two parts: personal factors and working factors [2] The Nordic Musculoskeletal Questionnaire (NMQ), a reliable and valid tool widely used to report the prevalence of MSK disorders, was used [3]. Third, for an ergonomic assessment of the subject, specifically during the performance of work (surgery), the Rapid Entire Body Assessment (REBA) scale [20]. was employed. Finally [4], a form for noting the coping strategies employed by the subjects was also included.

Personal and working factors

For personal factors, questions were asked regarding age, sex, and BMI. The participants' marital status, lifestyle, hand dominance status, contact information, and smoking habits were also recorded. The subjects were also asked about their work experience, experience in surgery, number of working hours, and number of working days per week. In addition, the surgeons were asked about their preferred surgical approach, dominant posture and average workload over the past 6 months.

Screening for musculoskeletal disorders

The researcher conducted a screening of the Nordic Musculoskeletal Questionnaire (NMQ) among surgeons to determine the prevalence of work-related musculoskeletal pain [21], which may be linked to their professional practice. There are nine major body regions that the NMQ is commonly used to assess, including the neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet [22].

The Rapid Entire Body Assessment (REBA) scale

This method was developed by Sue Highnett and Lynn McAtammeny at Nottingham Hospital (the United Kingdom) and was published in 2000. This is the result of cooperative work carried out by teams of ergonomic physiotherapists and nurses after identifying/analysing approximately 600 working postures. The REBA is able to quantify the level of risk, ranging from very high risk to negligible risk, by allowing an individual to observe and analyse the posture of 9 different body regions [20]. The standardized version of the REBA was used, and the scores were calculated using the online resource Ergo-Plus.

Recording of coping strategies

A coping strategies form was used to assess the variety and number of coping strategies employed by the participants. The overarching goal is to quantify and identify the coping strategies most commonly employed by surgeons all over Sialkot city.

Data collection procedure

General and laparoscopic surgeons working in selected tertiary care hospitals were enrolled using simple random technique from all over Sialkot city. The respective medical superintendents were approached by the principal investigator(s) to be allowed to collect data from surgeons currently available and working at their hospitals. The investigators interviewed the surgeons at different tertiary care hospitals, following the convenience of the

Table 1 Demographic information of the participants. (*N* = 171)

Variables	*N*	%	Mean ± SD
Age			33.47 ± 9.75
< 40	121	71	
≥ 40	50	29	
Gender			
Male	76	44	
Female	95	56	
Body Mass Index			23.84 ± 3.74
Underweight	22	13	
Normal	95	56	
Overweight	44	26	
Obese	10	5.8	
Lifestyle			
Sedentary	115	67	
Active	56	33	
Smoking Habits			
Current Smoker	4	2.3	
Ex-Smoker	10	5.8	
Non-Smoker	157	92	
Hand Dominance			
Right-Handed	152	89	
Left-Handed	19	11	
Work-Related Information of the Participants			
Type of Surgeon			
General Surgeon	121	70.8	
Laparoscopic Surgeon	50	29.2	
Dominant posture during Surgery			
Standing	158	92.4	
Sitting	13	7.6	
Experience in medical field (Years)			8.94 ± 9.34
1–10	129	75.4	
11–20	28	16.4	
≥ 21	14	8.2	
Experience in Surgery (Years)			6.46 ± 8.68
1–10	143	83.6	
11–20	17	9.9	
≥ 21	11	6.5	
Average No. of surgeries (Weekly)			14.89 ± 10.45
1–10	41	24	
11–20	46	26.9	
21–30	46	26.9	
≥ 31	38	22.2	
Average Hours of Sleep (daily)			6.67 ± 1.24
< 7 h	94	55	
≥ 7 h	77	45	
Working Hours (weekly)			58.37 ± 19.53
≤ 40	41	24	
41–60	60	35.1	
> 60	70	40.9	
No. of Off Days due to MSK problems per month			1.083 ± *0.32*
None	122	71.3	
1–2	37	20.7	
> 2	12	7.1	
Total	171	100	

participants being interviewed. The data were collected from 171 surgeons, and face-to-face interviews were conducted with all of them.

The investigator underwent standardised interviewer training to ensure consistency and reliability of the data. A panel of experts reviewed the questionnaire to ensure it met the study objectives. A questionnaire was developed incorporating the changes proposed by the expert panel. To determine the validity and content of each question, a pilot study was conducted before the survey began.

Written consent was obtained from each participant before their data collection. This study was ethically approved by the Institutional Review Board of Riphah International University.

Statistical analysis

For the analysis of the data, the Statistical Package for Social Sciences (SPSS) Version 25 was used (IBM Corp, Armonk, NY, USA). The means and standard deviations of the quantitative data, such as the participants' height, weight, BMI, and level of experience, were calculated for each individual participant. Logistic regression was used to determine associations between musculoskeletal disorders and personal and working factors, including postural demands during general and laparoscopic surgery. The odds ratio and the 95% confidence interval were used to determine the risk. To identify the determinants of WRMSDs, a univariate analysis was performed on the data. To determine the statistical significance of the differences, p-values that were equal to or less than 0.05 were calculated.

Results

The findings of our study demonstrated that out of the 171 participants, 55.6% were female and 44.4% were male. The mean age of the participants was 33.47 ± 9.75 years, and the average BMI was 23.84 ± 3.74. Overall, 70.8% of the 171 surgeons were general surgeons, while 29.2% were laparoscopic surgeons. Among the participants, the average experience in the field was 8.94 ± 9.34, and the average number was 19.89 ± 16.65. The table is also categorized by hours of sleep, working hours per day, years of experience in surgery, and number of off days due to MSK complaints. (Table 1). The findings of our study demonstrated that the overall prevalence of WRMSDs among surgeons over the past 12 months was 79.5%. General surgeons reported 76.0%, and laparoscopic surgeons reported 86.0%. (Table 2)

The findings of the current study revealed that the point prevalence (over the past 7 days) of WRMSDs among the participants was 24.5%. In contrast, the reported period prevalence was as high as 79.5%. A comparison of the region-based prevalence of WRMSDs among general and laparoscopic surgeons revealed that

Table 2 Period (12 months) and point (7 days) prevalence in body parts among participants ($n = 171$)

Body Parts	Last 12 months		7 days prevalence		Activity restriction		Physician visits	
	N	%	N	%	N	%	N	%
Overall	136	80	42	25	53	31	28	16
Neck	106	62	37	22	32	19	20	12
Shoulders	77	45	29	17	31	18	12	7
Upper Back	51	18	20	12	30	18	10	5.8
Elbows	14	8.2	10	5.8	15	8.8	6	3.5
Wrists Hands	32	19	12	7	20	12	4	2.3
Lower Back	75	44	35	21	42	25	21	2.3
One or Both Hips Thighs	35	21	19	11	23	14	8	4.7
One or Both Knees	44	26	14	8.2	23	14	7	4.1
One or Both Ankles, Feet	51	30	16	9.4	17	9.9	17	9.9

for period prevalence, general surgeons reported a higher prevalence of WRMSDs in the neck region (83.7%) than did laparoscopic surgeons, while the laparoscopic group had a higher prevalence of WRMSDs in the elbows and wrists/hands (20.9% and 32.6%, respectively). (Table 3)

The association of point prevalence (7 days) with personal and work-related factors of WRMSDs revealed a significant association between lifestyle and WRMSDs, with a p-value = 0.045, and with the number of surgeries per week, with a p-value = 0.004. Moreover, the incidence of WRMSDs was significantly higher among participants who had a sedentary lifestyle, and age, number of working hours per week and number of surgeries performed were significant risk factors for developing WRMSDs over a 12-month period ($p = 0.000$). (Table 4)

Table 5 illustrates the Rapid Entire Body Assessment (REBA) score, which reflects the working posture of general and laparoscopic surgeons. Importantly, none of the participants fell into the negligible risk category, highlighting the high risk faced by surgeons as professionals. Compared with general surgeons, laparoscopic surgeons seem to have relatively higher REBA scores. This may be because laparoscopic surgeons are at a much higher risk than general surgeons when the REBA is used.

The findings revealed that for coping strategies to reduce the risk of WRMSDs, 91% of the surgeons chose to adjust the bed/plinth height, which was by far the most common coping strategy. However, only 26.9% of the surgeons admitted to stretching before performing surgery. (Fig. 1). Only 3.9% of the laparoscopic surgeons did not modify their position to lower the risk of WRMSDs, which is in contrast to the 10.7% for general surgeons. (Fig. 2)

Discussion

Surgery as a profession has been definitively linked to being at high risk for developing WRMSDs. This study examined the prevalence of WRMSDs among surgeons, specifically highlighting the distinctions between general surgeons and laparoscopic surgeons.

Our study revealed that 24.5% of surgeons experienced musculoskeletal symptoms within the past 7 days, suggesting that although the long-term prevalence of WRMSDs is significant, acute symptoms occur less frequently. This indicates that although numerous surgeons face chronic issues, the intensity or occurrence of symptoms may fluctuate over shorter durations. The observation that general surgeons indicated a higher prevalence of WRMSDs in the neck region (83.7%) relative to laparoscopic surgeons is noteworthy. This aligns with research by Ohlsson et al. (2020), which indicates that surgeons engaged in open surgery, frequently necessitating prolonged bending over patients, have a higher likelihood of experiencing neck and upper back pain. Laparoscopic surgeons in our study exhibited a notably higher prevalence of WRMSDs in the wrists/hands (32.6%) and elbows (20.9%), indicative of the repetitive motion and forceful grip frequently necessitated by minimally invasive surgery. The relationship between these particular symptoms and the surgical procedures conducted underscores the necessity for tailored ergonomic interventions across various surgical specialties. The current study identified a 12-month prevalence of WRMSDs among surgeons at 79.5%, aligning with findings from existing literature. A systematic review by Epstein et al. indicated that the prevalence rates of WRMSD among surgeons ranged from 66 to 94% [23]. Auerbach et al. reported a 12-month prevalence of 81% among surgeons [24].

Our findings indicated a higher occurrence of WRMSDs in laparoscopic surgeons (86.0%) in contrast to general surgeons (76.0%). This is consistent with the findings from Zahiri et al., who indicated that minimally invasive surgeons experienced a notably higher prevalence of musculoskeletal symptoms compared to open surgeons (97% vs. 82%, $p < 0.05$) [25].

The higher incidence of neck-related WRMSDs among general surgeons (83.7%) and the increased prevalence of

Table 3 Point prevalence (7 days) and period prevalence (12 months) among general and laparoscopic surgeons with respect to body region

	Period Prevalence (12 Month)						Point Prevalence (7 Days)					
	Type of Surgeon						Type of Surgeon					
	General Surgeon		Laparoscopic Surgeon		Total		General Surgeon		Laparoscopic Surgeon		Total	
	N = 121		*N* = 50				*N* = 121		*N* = 50			
	N	%	N	%	N	%	N	%	N	%	N	%
Neck	77	63.60%	29	58.00%	106	62.00%	23	19.00%	14	28.00%	37	21.60%
Shoulder	49	40.50%	28	56.00%	77	45.00%	12	9.90%	17	34.00%	29	17.00%
Elbow	5	4.10%	9	18.00%	14	8.20%	5	4.10%	5	10.00%	10	5.80%
Wrist & Hand	18	14.90%	14	28.00%	32	18.70%	4	3.30%	8	16.00%	12	7.00%
Upper Back	30	24.80%	21	42.00%	51	29.80%	10	8.30%	10	20.00%	20	11.70%
Lower back	44	36.40%	31	62.00%	75	43.90%	20	16.50%	15	30.00%	35	20.50%
Hip/Thigh	25	20.70%	10	20.00%	35	20.50%	11	9.10%	8	16.00%	19	11.10%
Knee	30	24.80%	14	28.00%	44	25.70%	4	3.30%	10	20.00%	14	8.20%
Ankle	39	32.20%	12	24.00%	51	29.80%	12	9.90%	4	8.00%	16	9.40%

elbow and wrist/hand disorders in laparoscopic surgeons (20.9% and 32.6%, respectively) in our study is partially corroborated by existing literature. Alqahtani et al. conducted a study revealing that neck pain was the predominant complaint among surgeons, affecting 82.9% of the participants. Nonetheless, they indicated elevated occurrences of lower back pain, which were less evident in our results [26].

This study also found that MSD prevalence varied by area, with 62% in the neck, 45% in the shoulders, and 43.9% in the lower back. Szeto et al. (2009) found similar results: 82.9% in the neck, 57.8% in the shoulders, 68.1% in the lower back, and 52.6% in the upper back [10]. Possible explanations for the marginally lower incidence rates in our study include contextual differences and the existence of confounding variables such coping mechanisms.

This study also compared the prevalence of WRMSDs among general and laparoscopic surgeons. According to our data, the prevalence rates were 76.0% for the general surgeon population and 86% for the laparoscopic surgeon population. Laparoscopic surgeons were found to be at higher risk of developing WRMSDs, with regional prevalence rates of 62% in the neck, 45% in the shoulders, 17% in the upper back and 43.9% in the lower back. A study by Guiterrez-Diez reported similar results, showing a high prevalence rate of 90% among laparoscopic surgeons. The most affected zones were the lower back (54%), neck (51%), upper back (44%) and shoulder (29%) [27].

The study identified numerous personal and work-related risk factors that are significantly associated with the development of work-related musculoskeletal disorders. Personal factors such as age and lifestyle were significantly linked to the prevalence of MSDs. Among work-related factors, only the total number of surgeries performed and total working hours appear to be significant. No association was found between the number of years of experience and the prevalence of work-related musculoskeletal disorders. These findings are in agreement with the work of Park et al., who found that there was a direct correlation between a higher frequency of cases and/or a higher workload and reported cases of MSK pain and discomfort [28].

This study examined the association between personal and work-related factors and the occurrence of WRMSDs. Surgeons who work longer hours and have extensive experience are likely to encounter increased physical strain. This aligns with the findings of Kirk et al. (2021), which indicate a strong association between overall work hours, prolonged surgery durations, and musculoskeletal complaints. Sleep deprivation has been identified as a contributing factor to musculoskeletal pain in multiple studies (e.g., Patel et al., 2017), potentially elucidating why surgeons with reduced sleep report

Table 4 Association of the period of incidence (12 months) of WRMSDs with personal and work-related factors among participants

Variables	MSK Disorders Period Prevalence (12 Month)						MSK Disorders Point Prevalence (7 Days)					
	Type of Surgeon						Type of Surgeon					
	General Surgeon		Laparoscopic Surgeon				General Surgeon		Laparoscopic Surgeon			
	N = 92		*N* = 43				*N* = 25		*N* = 17			
	N	%	N	%	X^2	p-value	N	%	N	%	X^2	P value
Age (years)					0.001	0.977					1.078	0.299
< 40	58	63.00%	27	62.80%			17	68.00%	14	82.40%		
> 40	34	37.00%	16	37.20%			8	32.00%	3	17.60%		
Body mass index					0.779	0.854					0.141	0.987
Underweight (< 18.5)	9	9.80%	3	7.00%			2	8.00%	1	5.90%		
Normal weight (18.5–24.9)	51	55.40%	25	58.10%			16	64.00%	11	64.70%		
Overweight (25–29.9)	25	27.20%	13	30.20%			6	24.00%	4	23.50%		
Obesity (> 30)	7	7.60%	2	4.70%			1	4.00%	1	5.90%		
Gender					2.788	0.095					1.14	0.286
Male	44	47.80%	14	32.60%			13	52.00%	6	35.30%		
Female	48	52.20%	29	67.40%			12	48.00%	11	64.70%		
Smoking Status					7.688	0.021					4.233	0.12
Current-smoker	0	0.00%	3	7.00%			0	0.00%	2	11.80%		
Ex-smoker	3	3.30%	3	7.00%			1	4.00%	2	11.80%		
Nonsmoker	89	96.70%	37	86.00%			24	96.00%	13	76.50%		
Marital Status					3.969	0.046					2.973	0.085
Married	43	46.70%	28	65.10%			8	32.00%	10	58.80%		
Unmarried	49	53.30%	15	34.90%			17	68.00%	7	41.20%		
Life style					1.622	0.203					0.075	0.784
Sedentary	77	83.70%	32	74.40%			20	80.00%	13	76.50%		
Active	15	16.30%	11	25.60%			5	20.00%	4	23.50%		
Hand Dominance					1.435	0.231					0.44	0.507
Right-sided	79	85.90%	40	93.00%			22	88.00%	16	94.10%		
Left-sided	13	14.10%	3	7.00%			3	12.00%	1	5.90%		
Experience in Medical Field (years)					11.019	0.004					12.425	0.002
1–10	79	85.90%	26	60.50%			22	88.00%	12	70.60%		
11–20	9	9.80%	11	25.60%			2	8.00%	4	23.50%		
≥ 21	4	4.30%	6	14.00%			1	4.00%	1	5.90%		
Experience in Surgery (years)					14.317	0.001					1.036	0.596
1–10	85	92.40%	30	69.80%			23	92.00%	14	82.40%		
11–20	3	3.30%	10	23.30%			1	4.00%	2	11.80%		
≥ 21	4	4.30%	3	7.00%			1	4.00%	1	5.90%		
Sleep/Day (hours)					0.65	0.42					0.115	0.735
< 7	51	55.40%	27	62.80%			16	64.00%	10	58.80%		
> 7	41	44.60%	16	37.20%			9	36.00%	7	41.20%		

Table 4 (continued)

Variables	MSK Disorders Period Prevalence (12 Month)						MSK Disorders Point Prevalence (7 Days)					
	Type of Surgeon						Type of Surgeon					
	General Surgeon		Laparoscopic Surgeon				General Surgeon		Laparoscopic Surgeon			
	N = 92		*N* = 43				*N* = 25		*N* = 17			
	N	%	N	%	X^2	p-value	N	%	N	%	X^2	P value
Working/Weekly (hours)					3.922	0.141					0.277	0.871
< 40	11	12.00%	5	11.60%			3	12.00%	3	17.60%		
41–60	39	42.40%	11	25.60%			9	36.00%	6	35.30%		
> 60	42	45.70%	27	62.80%			13	52.00%	8	47.10%		
No. of Surgeries/Week					3.227	0.358					3.622	0.305
1–10	14	15.20%	3	7.00%			0	0.00%	2	11.80%		
11–20	23	25.00%	14	32.60%			6	24.00%	5	29.40%		
21–30	32	34.80%	12	27.90%			10	40.00%	6	35.30%		
≥ 31	23	25.00%	14	32.60%			9	36.00%	4	23.50%		
No. of off days due to MSK problem/Month					2.132	0.344					4.23	0.121
None	62	67.40%	33	76.70%			15	60.00%	15	88.20%		
1–2	23	25.00%	6	14.00%			8	32.00%	2	11.80%		
> 2	7	7.60%	4	9.30%			2	8.00%	0	0.00%		

MSK: Musculoskeletal

Table 5 REBA scores of general surgeons and laparoscopic surgeons

		Type of Surgeon					
		General Surgeon			Laparoscopic Surgeon		
		Count	Row N %	Column N %	Count	Row N %	Column N %
Scoring for REBA	Negligible risk	0	0.0%	0.0%	0	0.0%	0.0%
	Low risk	6	60.0%	5.0%	4	40.0%	8.0%
	Medium risk	61	76.2%	50.4%	19	23.8%	38.0%
	High risk	36	73.5%	29.8%	13	26.5%	26.0%
	Very High Risk	18	56.2%	14.9%	14	43.8%	28.0%

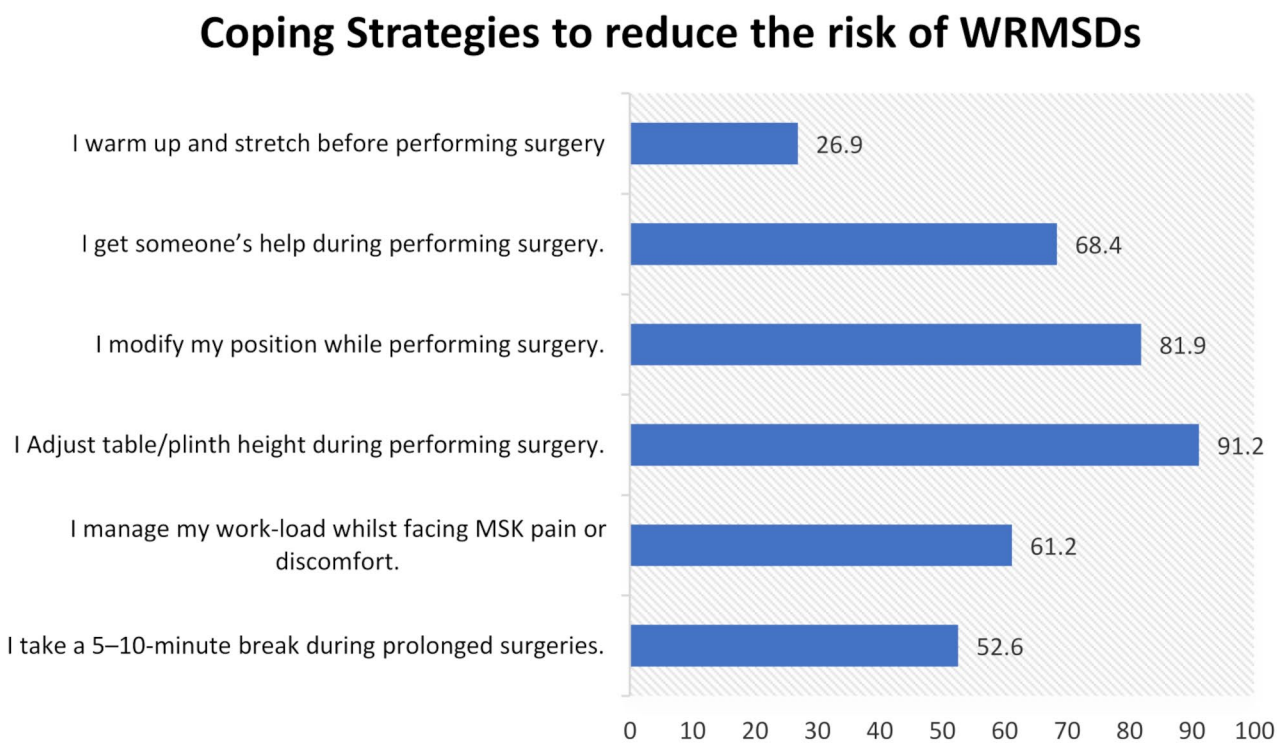

Fig. 1 Coping strategies adopted by surgeons to reduce the risk of WRMSDs

increased levels of discomfort. Subsequent analyses must investigate the role of these variables more thoroughly, including the impact of individual factors such as body mass index (BMI) and age on the development of WRMSDs.

This study examined the association between personal and work-related factors and the occurrence of WRMSDs. This study identified sedentary lifestyle, surgical workload, age, and working hours as significant risk factors, a finding supported by multiple studies. Yizengaw et al. conducted a study indicating that older age and higher years of practice correlate with elevated rates of WRMSDs [29]. The correlation between surgical workload and WRMSDs in our study ($p = 0.004$) aligns with the findings of Szeto et al., who indicated that elevated caseloads are associated with heightened musculoskeletal symptoms [10]. Furthermore, Surgeons who work longer hours and have extensive experience are likely to encounter increased physical strain. This aligns with the findings of Rata et al. (2021), which indicate a strong association between overall work hours, prolonged surgery durations, and musculoskeletal complaints [30].

The REBA scores obtained in the current study indicate that all participants encountered varying degrees of risk, raising more concerns compared to findings from some prior studies. Dabholkar et al. reported that 68% of surgeons were classified as medium risk and 32% as high risk [31]. The observed difference may result from the utilization of distinct assessment tools or variations in the surgical specialties examined. Work posture assessment by using the REBA score can also be considered an accurate indicator of risk level for developing WRMSDs among surgeons, with our findings showing that 47.3% of the participants fell into the high-risk category or above.

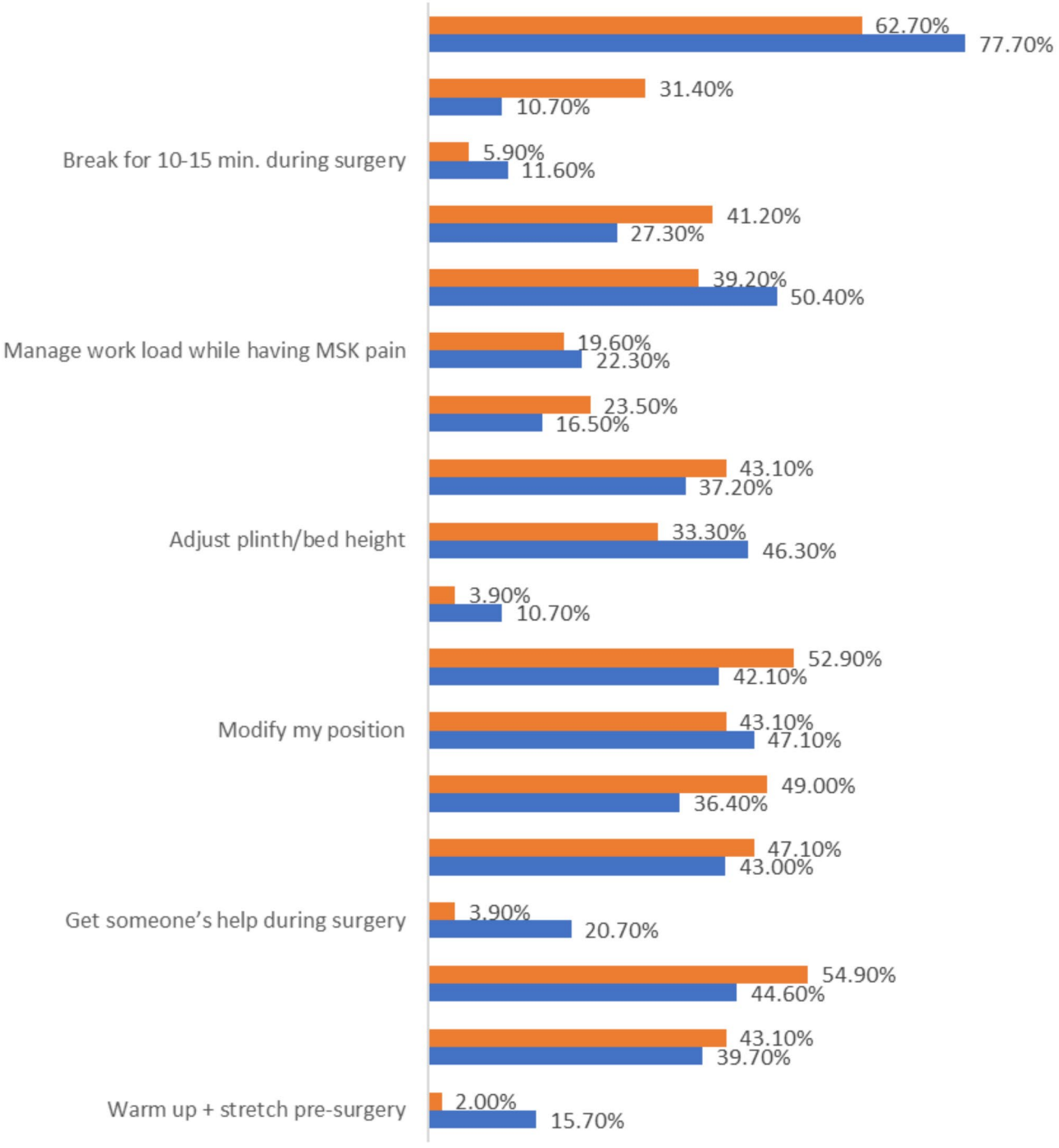

Fig. 2 Comparison of coping strategies employed between general and laparoscopic surgeons

Wibowo et al. also reported a significant correlation between the REBA score and the development of MSDs [32].

The observed rate of bed/plinth height adjustment (91%) as a coping strategy in our study is notable and exceeds rates documented in several other studies. Alqahtani et al. reported that only 45.7% of surgeons indicated they adjusted the height of the operating Table [33]. The reported low rate of pre-surgery stretching (26.9%) aligns with findings from other studies, indicating a prevalent opportunity for enhancement within the surgical domain. Moreover, in 2018, Salama et al. reported coping strategies employed by health care professionals, in their case, by nurses. Nurses' use of different parts of the body as a coping mechanism during nursing procedures (34.0%)

and changes in posture (30.0%) were the two most statistically significant coping strategies [34].

This study offers significant insights into the prevalence of WRMSDs among surgeons in Pakistan; however, it presents several limitations. The study is based on self-reported data, potentially leading to bias or inaccuracies in symptom reporting. Furthermore, recall bias may be possible, as the study involved asking the participants about their previous details. The sample size, while sufficient, is confined to a single institution or region, potentially impacting the generalizability of the results. Subsequent research involving larger and more diverse samples from various institutions may yield a more comprehensive understanding of the issue. Longitudinal studies would be essential for evaluating the long-term effects of WRMSDs on surgeons' careers and quality of life. In this study, convenience sampling was used, which may impact the representativeness of the samples. Furthermore, robust statistical analysis can be achieved by considering additional confounding factors, such as specific working conditions across hospitals.

This baseline study offers data for subsequent researchers to investigate WRMSDs in surgeons. Moreover, it is essential to develop appropriate training and awareness programs addressing risks to the musculoskeletal system within the surgical profession and propose effective coping strategies and modifications in workspace ergonomics and equipment to mitigate the risks encountered by surgeons. It is advisable for researchers to conduct additional studies on this topic across various cities to enhance awareness of risk factors among at-risk surgeons. Additionally, it is recommended to conduct longitudinal studies to monitor the evolution of WRMSDs over time and to analyses specific ergonomic interventions to reduce musculoskeletal disorders in surgeons.

Conclusion

This study revealed that both laparoscopic and general surgeons are at high risk for developing work-related musculoskeletal disorders. Laparoscopic surgeons exhibit overall a higher prevalence of work-related musculoskeletal disorder, whereas general surgeons are more prone to report neck region issues. Factors related to work, including hours worked, years of experience, and the type of surgery performed, significantly contribute to the development of these disorders. Targeted interventions are essential to mitigate the physical strain on surgeons, thereby safeguarding their health and maintaining the quality of care delivered. Future research must further investigate the diverse causes of WRMSDs and assess the efficacy of preventive strategies within surgical practice. Moreover, the most commonly employed coping strategies by general and laparoscopic surgeons were also recorded, where changing the bed/plinth height was the most commonly used strategy.

Abbreviations

MSDs	Musculoskeletal Disorders
WRMSDs	Work-related Musculoskeletal Disorders
ROM	Range of motion
MSK	Musculoskeletal
EPA	End product assessment

Author contributions

A.A.& M.K. participated in the design, drafting, writing, and collection and assembly of the data. A.J. and H.K. contributed to the study design. A. A & Q.A. participated in the calculation of the sample size and the statistical analysis. R.K. and K.F. participated in the study design and helped draft the manuscript and format the manuscript. Q.A., M.K and M.T.A. contributed to critical revision of the article for important intellectual content. All authors participated in the interpretation of the data and in the editing, figure preparation, critical revision and approval of the final manuscript and were accountable for the accuracy of the work.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the research and ethical committee of Riphah International University (REC-FSD-00547) and study adhered to the Declaration of Helsinki. Informed consent was obtained from all participants. Compliance with relevant guidelines and regulations was ensured throughout all processes.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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