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ORIGINAL ARTICLE

Work-related musculoskeletal disorders among clinical laboratory workers

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ABSTRACT

Aims and Objectives: The aim of this study was to estimate the prevalence and risk factors of work-related musculoskeletal disorders (WMSDs) among clinical laboratory workers. **Materials and Methods:** This questionnaire-based cross-sectional study included the clinical laboratory departments of six governmental tertiary and secondary hospitals in Riyadh, Saudi Arabia. The selected instrument was a self-administered adapted standardized questionnaire. The sample comprised 306 laboratory workers, and the selected sampling technique was a non-random convenient method. **Results:** The overall prevalence of WMSDs in any body region was 82% in the last 12 months; it was mainly linked to lower back pain (61%). In the logistic regression, age <30 years, working in specific laboratories and working in hematology/flow-cytometry laboratory divisions were all found to be significant risk factors ($P < 0.05$). **Conclusion:** Clinical laboratory workers are at a high risk for WMSDs; it is essential that we take preventative action to address this.

Key words: Ergonomics, laboratory workers, musculoskeletal disorders, occupational hazards, work-related musculoskeletal disorders

INTRODUCTION

Musculoskeletal disorders (MSDs) are a significant cause of physical limitation affecting humans around the globe.[1] MSDs can cause severe physical impairment, pain, and can greatly alter the psychosocial status of the affected individuals.[1] In 2016, The Global Burden of Disease (GBD) study reported that MSDs were the second most common cause of disability worldwide, with back pain as the leading cause. Approximately 20%–30% of people worldwide live with a musculoskeletal condition.[2]

MSDs can be work-related. The World Health Organization (WHO) defines MSDs as "multifactorial, with work contributing significantly, though not exclusively, to causing the disease."[3] Work-related musculoskeletal disorders (WMSDs) can result from or be worsened by recurrent, vigorous, or prolonged work activities with inadequate recuperation.[3] The U.S. Department of Labor tracks workplace injuries, publishing the statistics annually.[4] In 2016 in the private sector, WMSDs accounted for at least 32% of nonfatal injury cases resulting in days away from work.[4] The incidence rate of MSDs ranged between 29.4 and 44.7 cases per 10,000 full-time equivalent local government workers.[4] Clinical laboratory employees work long hours in a confined seated or standing position. Their work involves continuous repetitive hand movements, such as during pipetting—this is of major concern. The important risk factors of hand\wrist injuries include frequent movement of the arm or wrist, motions that require extremes of hand or arm position, and sustained static postures, and vibration.[5]

In a review of previous studies measuring the risks of developing WMSDs among laboratory workers, one

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work conducted in the Washington, D.C. metropolitan area examined musculoskeletal symptoms among cytotechnologists. The results showed that 61.5% of the participants reported neck pain, 56.4% reported hand/wrist pain, and 42.3% had lower back pain.[6] In a cross-sectional study investigating 156 workers in 30 clinical laboratories in Iran in 2014, the prevalence of reported WMSDs in the past 12 months was 72.4%.[7] Another study conducted on 130 male and female laboratory technicians in the Indian health-care industry reported a prevalence of 66.9% WMSDs in the last 12 months. The highest prevalence in this study was reported in back pain, at 44%.[8]

In the Saudi Arabian context, a study conducted in Riyadh determined the prevalence of WMSDs among physiotherapists; the results revealed that 81% of the physiotherapists were affected.[9] The prevalence of WMSDs among ophthalmologists and optometrists at a tertiary hospital in Saudi Arabia was found to be approximately 70%.[10] Another study in Saudi Arabia estimating WMSDs among dental professionals reported that 85% of them had developed work-related pain after joining the dental profession.[11]

A review of previous studies conducted among research laboratory workers in Saudi Arabia revealed a WMSD prevalence in the past 12 months of 52.04%.[12] However, no related studies on general clinical laboratory workers in Saudi Arabia were found. Therefore, the aim of this study was to estimate the prevalence and risk factors associated with WMSDs among major clinical laboratory workers in Riyadh, Saudi Arabia from 2016 to 2018.

MATERIALS AND METHODS

This questionnaire-based[13] cross-sectional study investigated WMSDs in the clinical laboratory departments of six governmental hospitals in Riyadh, Saudi Arabia, including King Abdulaziz Medical City (KAMC), King Khalid University Hospital (KKUH), Prince Mohammed Bin Abdulaziz Hospital (PMBAH), Prince Sultan Military Medical Centre (PSMMC), King Fahad Medical City (KFMC), and Security Forces Hospital (SFH). The study was conducted on clinical laboratory workers; both genders were studied, and the participants comprised Saudi and non-Saudi nationals. Workers with previous MSD\injury, pregnant female workers, laboratory workers involved only in administrative work, new employees with less than one year of employment, and research laboratory workers were excluded.

Musculoskeletal complaints of different parts of the body (lower back, neck, shoulders, hands/wrists, hips/thighs, and ankles or feet) in the past 12 months were ascertained with the standardized Nordic Musculoskeletal questionnaire.[13] It was presented to participants with anatomic diagrams that highlighted each part of the body for clarity. If symptoms were present, participants were asked to answer additional questions regarding the duration of these symptoms, to indicate whether these symptoms were present in the past seven days, to answer whether it had affected their work activities, and to note whether they had seen a doctor or physiotherapist regarding their symptoms. The dependent variable was whether or not the laboratory workers had WMSDs. The independent variables included baseline characteristics such as gender, age, laboratory department, nature of the work, weight, height, dominant hand, number of working hours per week, and total duration the worker had been doing his or her job.

All the data were tabulated and analyzed by using Statistical Package for the Social Sciences software for Windows version 20 (IBM Corp., Armonk, N.Y., USA). Numerical data such as age and weight were presented as mean ± standard deviation (SD). Categorical data such as gender were presented as frequencies and percentages. A 95% confidence interval (CI) was generated for the prevalence of WMSDs in different body parts. A chi-square test was used to compare the association between WMSDs and job nature. Logistic regression was used to identify significant risk factors. A value of $P < 0.05$ was considered statistically significant.

RESULTS

A total of 736 self-administered questionnaires were distributed from 2016 to 2018. Of these, 376 questionnaires were returned and 292 questionnaires were deemed to be effective. The response rate for this study was 51%. The general characteristics of the laboratory workers are shown in Tables 1 and 2.

The overall prevalence of WMSDs in the last 12 months in any parts of the body was 82%. As shown in Table 3, pain events were reported in the following order of occurrence: lower back (61%), neck (46%), shoulders (45%), upper back (44%), wrists/hands (34%), ankles/feet (29%), knees (28%), hips/thighs (17%), and elbows (10%).

Pearson's chi-square test was performed to examine the relation between the nature of the job and pain sites. Those who performed manual work reported neck pain at a rate of 56.3%, whereas only 36.9% of workers who were not engaged in manual work had neck pain ($P = 0.001$). Shoulder pain was also

more prevalent in those whose duties involved manual work (51.1%) in comparison to those who did not (39%) ($P = 0.046$).

Employees who worked while standing reported lower back pain at a rate of 66.7% and pain in the ankles/feet at 33.5%.

Table 1: Characteristics of laboratory workers

Variable		*N* (%)	Mean (SD)
Gender	Female	165 (56.5%)	
	Male	127 (43.5%)	
Age (years)	<30	88 (33.1%)	35.02 (8.3)
	30–39	108 (40.6%)	
	40–49	50 (18.8%)	
	50+	20 (7.5%)	
Nationality	Saudi	148 (51.0%)	
	Non-Saudi	142 (49.0%)	
BMI group	Underweight	10 (4.2%)	
	Normal	95 (39.9%)	
	Overweight	86 (36.1%)	
	Obese	47 (19.7%)	
Dominant hand	Right	266 (91.4%)	
	Left	25 (8.6%)	
Hospital	PSMMC	30 (10.3%)	
	SFH	26 (8.9%)	
	KFMC	28 (9.6%)	
	NGHA	141 (48.3%)	
	KKUH	35 (12.0%)	
	PMAH	32 (11.0%)	
Lab type	Hematology/flow cytometry	41 (15.0%)	
	Blood bank	32 (11.7%)	
	Microbiology	38 (13.9%)	
	Chemistry/metabolic/ toxicology	55 (20.1%)	
	Serology/ tissue typing	26 (9.5%)	
	Histopathology/EM	25 (9.2%)	
	Cytogenetics	11 (4.0%)	
	Receiving and processing	45 (16.5%)	
Nature of job	Microscope	84 (29%)	
	Manual	137 (47.4%)	
	Standing	198 (68.5%)	
	Sitting	103 (35.6%)	

Those who did not report standing as the nature of their job had less lower back pain (47.8%) and less ankle/foot pain (17.8%) ($P = 0.002$) and ($P = 0.13$), respectively.

A total of 56.4% of workers whose jobs involved sitting reported neck pain. In contrast, only 40.4% of workers who do not perform their jobs sitting in a chair reported neck pain ($P = 0.01$). Interestingly, laboratory workers who mainly worked with microscopes did not have a specific pain site [see Table 5 for more details]. No relationship was found between the dominant hand and the presence of pain in shoulders or elbows. However, wrist and hand pain showed an association with the dominant hand ($P < 0.024$).

In the logistic regression analysis, a new variable was created and named: presence of any MSD. Here, any participant who reported body pain was counted. The risk factors that were studied are shown in Tables 4 and 5; they revealed a relationship between age <30 years and pain ($P = 0.031$) as well as a relationship between pain and the laboratory division the subjects worked in—specifically, hematology and flow cytometry ($P = 0.007$). It was obvious that the

Table 2: Prevalence of WMSDs

Site	Prevalence%, 95 CI
Neck pain	46 (40–52)
Shoulder pain	45 (39–51)
Elbow pain	10 (6–13)
Wrist/hand pain	34 (28–40)
Upper back pain	44 (37–50)
Lower back pain	61 (55–66)
Hips/thighs pain	17 (12–22)
Knees pain	28 (22–34)
Ankles/feet pain	29 (23–35)
Overall	82 (78–86)

Table 3: Logistic regression analysis of the risk factors associated with WMSDs

Variable		OR	95% CI	Significance
Gender	Female	1.29	[0.53, 3.17]	0.576
	*Male	1		
Age (years)	<30	8.29	[1.21, 56.59]	0.031
	30–39	4.64	[0.90, 23.99]	0.067
	40–49	1.74	[0.36, 8.41]	0.494
	*50+	1		
Hospital	PSMMC	7.37	[1.02,53.35]	0.048
	SFH	1.35	[0.23, 8.14]	0.742
	KFMC	0.79	[0.15, 4.24]	0.783
	NGHA	5.22	[1.30, 20.96]	0.02
	KKUH	1.86	[0.39, 8.90]	0.44
	*PMAH	1		
Laboratory division	Hematology/flow cytometry	0.15	[0.04, 0.59]	0.007
	Blood bank	0.52	[0.09, 3.08]	0.472
	Microbiology/molecular biology /molecular genetics/virology /cytogenetics	0.37	[0.10, 1.41]	0.147
	Receiving and processing	0.18	[0.02, 1.31]	0.09
	Histopathology/electron microscopy	1.1	[0.17, 7.19]	0.921
	*Chemistry/metabolic/toxicology/ serology/HLA and tissue typing	1		

*Reference group

Table 4: Dominant hand in relation to wrist/hand pain

Dominant hand	Wrist/hand pain				
	No pain	Right wrist	Left wrist	Both wrists	*P* value
	N (%)	*N* (%)	*N* (%)	*N* (%)	
Right	151 (65.4)	50 (21.6)	6 (2.6)	24 (10.4)	*0.024
Left	15 (71.4)	2 (9.5)	3 (14.3)	1 (4.8)	

* significant

Table 5: Pearson chi-squared tests for WMSDs in relation to job nature

		Microscope	Manual	Standing	Sitting
Neck pain	*N* (%)	41 (50)	76 (56.3)	94 (48.2)	57 (56.4)
	Chi-square	0.755	10.709	1.082	6.703
	df	1	1	1	1
	Sig.	0.385	.001*	0.298	.010*
Shoulder pain	*N* (%)	40 (48.2)	69 (51.1)	94 (48.2)	40 (39.6)
	Chi-square	0.45	3.984	2.706	1.782
	df	1	1	1	1
	Sig.	0.502	.046*	0.1	0.182
Elbow pain	*N* (%)	9 (12.3)	12 (9.8)	19 (11.1)	11 (12.6)
	Chi-square	0.885	0.011	1.359	1.387
	df	1	1	1	1
	Sig.	0.347	0.918	0.244	0.239
Wrist/hand pain	*N* (%)	23 (30.7)	49 (39.8)	62 (36)	31 (34.8)
	Chi-square	0.569	3.328	0.772	0.02
	df	1	1	1	1
	Sig.	0.451	0.068	0.38	0.888
Upper back pain	*N* (%)	30 (40)	52 (43.7)	77 (45.6)	36 (42.4)
	Chi-square	0.593	0.002	0.653	0.119
	df	1	1	1	1
	Sig.	0.441	0.962	0.419	0.73
Lower back pain	*N* (%)	47 (57.3)	88 (65.2)	130 (66.7)	61 (59.8)
	Chi-square	0.599	2.161	9.21	0.054
	df	1	1	1	1
	Sig.	0.439	0.142	.002*	0.817
Hips/thighs pain	*N* (%)	13 (17.8)	14 (12.4)	32 (19.9)	12 (15)
	Chi-square	0.1	2.977	3.68	0.264
	df	1	1	1	1
	Sig.	0.752	0.084	0.055	0.607
Knees pain	*N* (%)	22 (29.7)	39 (33.3)	52 (31)	20 (23.8)
	Chi-square	0.161	3.072	2.214	1.172
	df	1	1	1	1
	Sig.	0.688	0.08	0.137	0.279
Ankles/feet pain	*N* (%)	18 (24.3)	33 (28.4)	56 (33.5)	18 (22)
	Chi-square	0.969	0.01	6.132	2.811
	df	1	1	1	1
	Sig.	0.325	0.92	.013*	0.094

* significant

prevalence of WMSDs at certain laboratories was higher: KAMC ($P = 0.02$) and PSMMC ($P = 0.048$). In addition, a clear association was found between how long a laboratory worker has held her/his job in years working in laboratories in general and WMSDs ($P = 0.006$). Working hours did not seem to be relevant.

DISCUSSION

The prevalence of WMSDs among laboratory workers in Riyadh was found to be high. This study suggests that age, duration of work, laboratory division, and nature of the job are all risk factors for developing WMSDs.

Eighty-two percent of the respondents reported at least one musculoskeletal complaint in the last 12 months, which was higher than that had been published in a similar study in Iran (72%).[7] Previous studies found lower back pain to be the most common WMSD among health workers, with a prevalence ranging from 60% to 69%.[7,11,14] Similarly, the prevalence of lower back pain in this study was the highest of all the parts of the body, at 61%.

Studies from around the world have revealed MSDs to be associated with gender.[7,11,15] However, in this study, no relationship to gender was found. Age was significantly associated with WMSDs, corresponding to the findings

of other studies.[7,11,14,15] There was a higher prevalence in participants aged less than 30 years compared to older participants. This might be due to overload in the work setting, as most of the time, the seniority that comes with experience in laboratories implies less technical work. Faulty ergonomics or incorrect techniques could also be to blame, which might be more expected in young less experienced laboratory worker.[11]

A statistically significant association between laboratory setting and WMSDs was observed, with the prevalence of WMSDs among certain facilities being higher than others: KAMC and PSMMC. The daily number of samples that each center received and processed was compared, and the highest numbers were found at KAMC and PSMMC, at 15,000 and 20,000, respectively. Furthermore, certain laboratory divisions were related to a higher prevalence of WMSDs—here, hematology and flow cytometry.

This study's findings linked the nature of the job to the affected parts of the body. The workers who mainly performed manual tasks were more prone to neck and shoulder pain. Neck pain may arise from the head being held too close to work material, whereas repetitive action and awkward posture may cause shoulder pain.[16] Global studies showed a significant role of long periods of standing in back and foot pain.[17,18] In line with previous studies, this study revealed a relation between standing, lower back pain, and foot pain. There was also a reduction in work and leisure activities because of WMSDs. Out of 50% of respondents who reported shoulder pain in the last 12 months, 52% reported reduced work activity and 48% reported reduced leisure activity because of shoulder pain. However, only 26% had seen a doctor for these complaints.

This study has some limitations: a self-reported questionnaire was used to collect data without any clinical examination to confirm the presence of symptoms and exclude overestimated self-reported musculoskeletal complaints. Also, the sample size was limited to secondary and tertiary hospital laboratory workers; they may not represent all laboratory workers in Riyadh due to the possible workload difference.

CONCLUSION

Clinical laboratory workers are at a high risk for WMSDs, and it is necessary to take appropriate and effective corrective preventive action to prevent them from WMSD reoccurrence. This study showed that the incidence of WMSDs of the lower back, neck, and shoulders was higher than other parts of the body. Screening and management of these highly vulnerable sites could play a primary role in reducing WMSDs injuries. A first step would be to provide education about proper body mechanics during work duties and to conduct research evaluating the laboratories' working environments.

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Conflicts of interest

There are no conflicts of interest.

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