

A Study on musculoskeletal complaints and working postures in pathology specialists in Iran

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Abstract

Background: Musculoskeletal disorders (MSDs) are one of the most common causes of occupational injuries and disabilities among health care workers. This study investigates the relationship between musculoskeletal complaints and pathologist postures in laboratories.

Method: In this cross-sectional study, 40 pathologists and residents were evaluated. Data was collected by Nordic questionnaire. For postural analysis, 20 minutes film was recorded while using a microscope by subjects. Posture analysis was done by the Rapid Upper Limb Assessment (RULA) method and their repetitive movements were scored. The data was analyzed by SPSS Version 20.

Results: The mean age and duration of employment of subjects was 36.57 ± 7.54 years and 6.50 ± 6.30 years, respectively. Most MSDs were found in neck (65%), wrist (57.5%), upper back (50%) and lower back (47.5%). The mean RULA grand score was higher in patients with upper back and shoulder pain. A statistically significant relationship was found between the mean RULA A, the upper back pain ($P=0.02$) and the wrist pain ($P=0.003$), as well as between the mean RULA B, the neck pain ($P=0.02$) and the lower back pain ($P=0.05$). The results showed a significant relationship between duration of employment and weekly work hours.

Conclusion: This study revealed high prevalence of MSDs among the pathologists. Therefore, performing ergonomic corrective actions is essential in order to improve their physical conditions at work.

Background

As each person spends more than one third of own life in the working environment, the hazardous factors of the workplace, including ergonomic factors, affect the individual's health. Work-related musculoskeletal disorders (WMSDs) reduce the power and quality of work, increase the treatment costs and lost work time and result early disability [1].

The National Institute for Occupational Safety and Health (NIOSH) classifies the musculoskeletal discomforts in the second rank of work-related illnesses and complications based on their importance in terms of prevalence and severity [2]. Biomechanical risk factors causing or exacerbating MSDs includes repetitive movements, inappropriate postures, frequent carrying heavy loads, excessive force, delicate and repetitive works and vibration, among which the inappropriate posture is the most common and important risk factor [3]. The WMSDs constitute a considerable part of MSDs and include complications from work activities that occur mainly due to repetitive muscle activity and repeated mechanical pressure [4]. Annually the Occupational Safety and Health Administration (OSHA) reports 200 cases of WMSDs compensation claims, including carpal tunnel syndrome (CTS), tendonitis, tenosynovitis, epicondylitis, and low back pain [5]. The main risk factors of MSDs are high physical activity, poor body fitness, repetitive movements, and pressure on the body due to local contact with objects. In all cases, contact duration and magnitude of these factors are considerably significant [6]. Individual characteristics, such

as height, gender, race, socioeconomic factors, and coping ability to stress, affect the development of these disorders [7].

Evidence suggests a significant relationship between awkward working postures and pain and musculoskeletal system damage. The awkward working posture is defined as a significant deviation from the natural posture. Some example of these awkward working postures includes back stretching, wresting, overhead working, wrist rotating, knee ling forward and backward bending and squatting [8].

In the study of MacDonald K and King D [9] (2014) on in veterinary echo cardiographers showed Pain is common (44%) in veterinary echo cardiographers, is significantly associated with gender, and affects job performance for over one-third of pain sufferers.

Study on Correlation between risk factors and MSD among classical musicians showed

The biomechanical risk factors that predict playing related musculoskeletal disorders are mainly associated with the upper limbs [10].

Pathologists are at higher risk of developing musculoskeletal symptoms due to repetitive movements, long-term work in unceasing static conditions and uncomfortable working conditions. The prevalence of musculoskeletal symptoms at least in one organ among medical laboratory technicians have been reported to be between 72.5% to 92.3% [2]. In previous studies in Iran, the prevalence of symptoms of MSDs were assessed in pathologists and the most common complaints were pain in neck (33.3%) followed by shoulder (9.8%) and elbow (8.7%) [11,12]

Considering the importance of the health of specialists and personnel working in the pathology department as one of the main pillars of the health system, and because most of these people suffer from inappropriate postures during work, this study aimed to evaluate the prevalence of MSDs symptoms in pathologists by using the RULA tools and also the influential factors on developing WMSDs in this group were assessed.

Methods

Study population:

This is a cross sectional study of all pathology specialists and residents in Mashhad University of Medical Sciences in 2018. The purpose of the study was explained to participants and all who agreed to participate provided oral informed consent. This study was done according to the approved research proposal number 950455 and all methods were used in this study was approved by Mashhad University Medical Sciences ethics committee in number IR.MUMS.fm.REC.1395.437. All subjects with congenital musculoskeletal disorders or chronic rheumatologic diseases and those with a history of severe trauma were excluded from the study.

Instruments:

The instrument used in this study to evaluate musculoskeletal disorders in different body area was Nordic questionnaire, which was developed in Occupational Health Institute in Nordic countries to assess MSDs in 1987 and was validated in previous studies [13].

The Nordic questionnaire has been designed in four sections consisting of general questions, determining the complications and discomforts of the organs, detecting the status of the workplace leaving due to discomfort of the organs and discomfort details in eight parts of the neck, upper back, lower back, shoulder, femur, knee, wrist and ankle. The questionnaire was completed by participants under the supervision of an occupational medicine resident or a trained expert.

Rapid upper limb assessment (RULA) was used to evaluate upper extremities MSD risk factors in pathologists. The RULA method was developed by two ergonomists in Nottingham University in England in 1993 named Dr. Lynn Mc Atamney and Professor E.Nigel Corlett [6]. This tool assesses the biomechanical and postural risk factors to a worker. In this study, a trained expert in occupational health and safety recorded a 30-40 minutes video from pathologists and their most repeated movements were extracted for analysis by RULA instrument. A single worksheet was used to analyze posture, exertion force and repetition of movements. The evaluator assigned the score to the postures of arm, forearm and wrist in section A in worksheet, and to the postures of neck, trunk and leg in section B. The Final RULA score was generated from the sum of the RULA A and RULA B. Then final RULA score categorized into four level of MSD risk as follows:

- Level 1 (final RULA score: 1-2): Negligible risk, acceptable postures
- Level 2 (final RULA score: 3-4): Low risk, further examination and probably the need for postural change
- Level 3 (final RULA score: 5-6): Medium risk, further examination and the need for postural change soon
- Level 4 (final RULA score: 7+): Very high risk, further examination and the need for postural change immediately.

Data analysis:

All quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were reported as exact number and percent. For comparison between the means, the student's t test or the Mann-Whitney U test was used after assessing the condition of normality by Kolmogorov-Smirnoff test. The chi-square test or Fisher's exact test was used to evaluate the association between qualitative variable. The binomial logistic regression was then run to determine the factors significantly associated with MSDs in upper body areas in pathologists. Data were analyzed using SPSS (Statistical package for social science) version 11.5. In all calculations the statistically significance level was considered as <0.05 .

Results

A total of 40 pathologists were enrolled in the study. The mean age of the subjects was 36.57 ± 7.54 years and the mean duration of occupation was 6.50 ± 6.30 years. According to the pathologist's report, the mean weekly working hours was 45.15 ± 12.84 . The mean height, weight and body mass index (BMI) of the participants were 165.75 ± 9.95 cm, 66.05 ± 12.25 kg and 23.83 ± 23.6 kg/m² respectively. A summary of participant's characteristics was presented in table 1. The prevalence of self-reported MSDs symptoms in different area of the body during the past 12 months which assessed by Nordic questionnaire, was shown in figure 1. The mean RULA A was 5.55 ± 0.87 and the mean RULA B was 4.67 ± 0.52 . The relationship between MSDs and working posture scores was shown in Table 2.

The RULA grand score was 3 or 4 in 8 (20.0%), 5 or 6 in 27 (67.5%) and 7 in 5 (12.5%) subjects. The relationship between MSDs and Final RULA score was presented in Table 3.

Table 4 show the presence of MSDs in participants based on their age, duration of occupation, mean weekly working hours and BMI.

In multivariate analysis, using logistic regression, the results showed that age and final RULA score had independent effect on neck pain. In addition, BMI and final RULA score were self-determining variables in developing pain in upper back. (Table 5)

In this study the chi-square test did not show statistically significant association between gender, dominant hand, smoking and presence of heart disease and developing pain and discomforts in neck, upper back, lower back, shoulder, thigh, knee, wrist and ankle.

Discussion

The aim of this study was to determine the relationship between musculoskeletal complaints and working postures among pathology specialists working at the laboratories affiliated to the Mashhad University of Medical Sciences. The mean age of the subjects was 36.57 years. The results showed the majority of female sex (67.5%) in our study.

The highest incidence of MSDs among the subjects was in the neck (65%), wrist (57.5%) and upper back (50%). The MSDs were also observed in other areas of the lower back (5/47%), shoulder (40%), knee (30%), ankle (12.5%) and thigh (12.5%), respectively. This situation may be due to inappropriate design of workstations. Occupations in laboratory work, such as office jobs, often require a static position in the body due to their occupational status and sitting down on the chair over a long period of time, which has recently been reported as a major risk factor for the neck pain [14]. Ortiz-Hernandez et al. also showed an increase in the risk of developing MSDs in computer-related staff [15]. They introduced the use of the mouse, sitting so long, poor postures and psychological factors as risk factors in the increased prevalence of MSDs. Bergqvist U et al. reported the effective role of ergonomic factors, such as static postures, awkward hand postures, improper seat armchairs, repetitive movements, inappropriate placement of monitor and keyboard, in the prevalence of MSDs [16]. Among the pathologists, the posture while working with a microscope, computer and other devices make a situation where they are forced to

put their neck and waist in an inappropriate condition, and the awkward design of workstations is exacerbating this issue.

Falaki et al. conducted a descriptive cross-sectional study reported that the incidence of neck pain was higher than other body organs [11]. Rahimi et al. carried out a descriptive cross-sectional study in Iran, on the WMSDs among pathologists [12]. The highest prevalence of WMSDs within 12 months was reported in the neck (33.3%), followed by the shoulder and the elbow pain that was 21.6%. Maulik S et al. in India studied the working ergonomic assessments and the prevalence of musculoskeletal symptoms among the technicians in medical diagnostic laboratories [17]. Overall incidence of MSDs experienced by technicians was 73.3% in the trunk, knees and ankles. There was also a significant difference between the mean scores before and after working shift in the neck, waist and knees.

Regarding the studies in other similar occupations, Nokhostin et al. examined musculoskeletal disorders and its complications among dentists [18]. They showed that 67.5% of dentists suffered from physical disorders including neck (51.8%), wrist (92.9%) and elbows (11.11%) and shoulder (7.4%) discomforts. In a study of Rafeemanesh et al. the prevalence of MSDs in different parts of the body in dentists was obtained in the neck (75.9%), shoulders (58.6%), upper back (56.9%), lower back (48.3%) and wrists (44.8%) [19]. In a study by Juul-Kristensen et al. on 1428 office workers, it was found that the MSDs are high in such occupations and are the highest in the neck, back and shoulders [20]. Kristensen et al. also showed that the incidence of these discomforts in office personnel in the neck, waist and shoulder areas was higher than in other parts. In the studies of Szeto et al. on surgeons and Kumar et al. on dentists, the neck has had the highest MSDs [21-22]. The results of all these studies are in line with the findings of this study, indicating a high prevalence of MSDs in the neck and waist; a slight difference in the prevalence can be attributed to the nature of the work. In general, undoubtedly, the high prevalence of MSDs among the pathologists in the present study indicates the harmfulness of the working conditions and environment in this profession and their awkward physical postures during work.

The mean duration of occupation was 6.50 ± 6.30 years and the mean weekly working hours was 45.15 ± 12.84 hours in the subjects of this study. The interaction of long-term sitting position and the awkward workplace conditions may cause long-term static contraction of the muscles, hereby increasing pressure on the intervertebral discs, inducing muscle tension on the ligaments and muscles, reducing tissue flexibility and changing in the spine curvature. Therefore, the present study also found a high prevalence of MSDs in the upper back and the lower back areas. Meanwhile, the results of the statistical tests demonstrated a significant relationship between the mean duration of occupation of the subjects and the neck and lower back pain. There was also a significant relationship between the mean weekly working hours in the subjects and the discomfort in the thigh, upper back, wrists and ankles. In this case, the research has also shown that increasing daily work hours is associated with the prevalence of MSDs confirming the results of our study [23].

There was a significant relationship between the mean age of subjects and neck, knee and ankle pain ($P=0.02$); the mean age was higher in people with discomfort in these areas. A significant association

($P=0.00$) was also observed between the age and the presence of MSDs in the study of Nokhostin et al. [18]. The subjects in this study, only 1 (2.5%) had a history of smoking. Other demographic data indicated that the mean BMI of the physicians present in the study was $23.83 \pm 2.16 \text{ kg/m}^2$. According to other examinations of the present study, the mean RULA grand scores was found to be 3 or 4 in 8 (20.0%), 5 or 6 in 27 (67.5%), and 7+ in 5 (12.5%). Further, the mean RULA *A* was 5.55 ± 0.87 , and the mean RULA *B* was 4.67 ± 0.52 . In addition, the mean RULA grand score was 5.25 ± 0.96 . Accordingly, it can be claimed that a majority the pathology specialists present in our study are within ergonomic level (3 and over) resulting in high risk of MSDs. Meanwhile, the score of 6 and over in about 80% of cases indicates severe awkward posture of the body and thereby the abnormal ergonomics of the body in this occupation. In the study of Maulik et al. the final RULA score was obtained to be 6 ± 1.02 , emphasizing poor workplace condition among medical laboratory technicians [17]. Their study showed that the prevalence of MSDs is high among medical laboratory technicians, and intervention of administrative and engineering controls can dramatically attenuate ergonomic risks, consistent with the results of our study. Therefore, all physicians present in our study should prioritize corrective actions, which should be done as soon as possible.

The statistical test results showed a significant relationship between the mean RULA grand score and upper back ($P=0.02$) and shoulder ($P=0.02$) pain during the last 12 months and the mean RULA score was higher in individuals with upper back and shoulder pain. There was also a significant relationship between the mean RULA *B* and neck pain ($P=0.02$) and back pain ($P=0.05$). A significant relationship was also seen between the mean RULA *A* and upper back and wrist pain ($P=0.003$), indicating poor workstation design resulting in abnormal posture. Falaki et al. observed a significant relationship between awkward posture and pain in the body organs and finally showed high prevalence of MSDs in the medical laboratory personnel [11]. The improper posture of these staff is of the main causes of these disorders and corrective ergonomic measures are needed to reconstruct the workstations in laboratories. In the study of Rafeemanesh et al. on dentists, the analysis of work using REBA showed that 89.6% of the organs in group *A* and 79.3% of the organs in group *B* had a score of 4 that shows an awkward posture in this occupation [19]. Florian Rudolf Fritzsche et al. also emphasized the need for clinical care and ergonomic interventions in the workplace among the population of pathologists in Switzerland [24].

The Chi-square test results showed no significant relationship between gender, dominant hand, smoking and heart disease in the study subjects and discomforts in the neck, upper back, lower back, shoulder, thigh, knee, wrist and ankle.

Among the subjects, the highest prevalence of MSDs was observed in the neck, the wrists, and the upper back and the lower back. These results will help to improve the working conditions and corrective actions, paying attention to the risk factors of these areas. Some of the most important reasons for high RULA score among pathologists can be attributed to the poor design of the workstation, the awkward setting of the desk containing tools and gadgets, the impossibility of adjusting the seat height, non-compliance with ergonomic principles by the pathologist due to lack of proper training in this field, or huge workload. Therefore, understanding and observing ergonomic principles in the workplace like the lab will reduce these issues. Therefore, reducing working hours or increasing the rest time, conducting tests periodically,

increasing accuracy in the correct positioning (such as allowing to adjust the height of the work desk, microscope, computer, and making available and standardizing other equipment) can be effective in the prevention of MSDs among the pathologists with high workloads.

Some of the limitations of this study were the small sample size and the lack of cooperation of some physicians (according to the self-report nature of the Nordic questionnaire). The psychological conditions in the workplace, occupational stress, and other external factors may also affect the outcomes of our project, which have not been addressed in this study.

Conclusion

The results of this study show revealed high prevalence of musculoskeletal disorders and awkward working postures among the pathologists. Therefore, it is essential to perform ergonomic corrective actions in order to improve the physical conditions of their working environment and prevent work-related musculoskeletal disorders.

Declarations

Ethics approval and consent to participate

The purpose of the study was explained to participants and all who agreed to participate provided oral informed consent. All methods were performed **in accordance** with the relevant **guidelines** and regulations. This study was done according to the approved research proposal number 950455 and all methods were used in this study was approved by Mashhad University Medical Sciences ethics committee in number IR.MUMS.fm.REC.1395.437.

Consent for publication

Not applicable

Availability of data and materials

The data that support the findings of this study are available from corresponding author but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Mashhad University of Medical Sciences.

Competing interest

The authors declare no conflict of interest with their funding bodies.

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Authors' contribution

- ER: Conception of the work, General supervision, Critical revision of the manuscript
- AK: design of the work, Data collection, literature review
- SN: Data analysis, Final approval of the version to be published
- TS: literature search, drafting the work, Data collection

all authors have read and approved the manuscript

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Tables

Table 1- Demographic characteristics of study population (n=40)

Variables		Frequency	percentage
gender	Female	27	67.5
	Male	13	32.5
BMI	Normal	29	72.5
	Overweight/Obesity	11	27.5
Dominant hand	Right	35	87.5
	Left	5	12.5
Smoking	Yes	1	2.5
	No	39	97.5

Table 2- Relationship between musculoskeletal complaints and working posture scores

Organs		RULA grand	RULA A	RULA B
Neck pain	Yes	5.38	5.56	4.80
	No	4.85	5.50	4.42
	P value	0.1	0.5	0.02
Upper back pain	Yes	5.55	5.58	4.80
	No	4.85	5.35	4.55
	P value	0.02	0.5	0.1
Lower back pain	Yes	5.15	5.57	5.57
	No	5.23	5.61	4.52
	P value	0.7	0.05	0.05
Shoulder pain	Yes	5.62	5.81	4.62
	No	4.91	5.45	4.70
	P value	0.02	0.1	0.6
Thigh pain	Yes	5.60	5.60	4.80
	No	5.14	5.60	4.65
	P value	0.3	1.00	0.5
Knee pain	Yes	4.91	5.41	4.75
	No	5.32	5.67	4.62
	P value	0.2	0.3	0.5
Wrist pain	Yes	5.30	5.91	4.60
	No	5.05	5.17	4.76
	P value	0.4	0.003	0.3
Ankle pain	Yes	4.60	5.60	4.40
	No	5.28	5.60	4.71
	P value	0.1	1.00	0.4

Table 3- Frequency of musculoskeletal complaints based on Final RULA score

RULA Score Organ	3-4 N (%)	5-6 N (%)	>7 N (%)	P value
Neck	3 (11.5)	19 (73.1)	4 (15.4)	0.17
Upper back	3 (15)	13 (65)	4 (20)	0.31
Lower back	4 (21.1)	13 (68.4)	2 (10.5)	0.93
Shoulder	1 (6.2)	11 (68.8)	4 (25)	0.06
Thigh	0 (0)	4 (11.5)	1 (11.5)	0.46
Knee	3 (25)	8 (66.7)	1 (8.3)	0.79
Wrist	5 (17.4)	14 (60.9)	4 (21.7)	0.47
Ankle	1 (20)	4 (80)	0 (0)	0.65

Table 4: Presence of musculoskeletal complaints in pathologists based on age, duration of occupation, the mean weekly working hours and BMI

	Age Mean (SD)	P-v*	Duration of occupation Mean (SD)	P-v	Mean weekly working hours Mean (SD)	P-v	BMI Mean (SD)	P-v
Neck	38.30 (8.11)	0.02	7.88 (7.26)	0.05	47.76 (12.70)	0.07	24.30 (2)	0.05
Thigh	37.6 (4.82)	0.7	6 (1.87)	0.6	32.4 (3.28)	0.00	23.83 (1.13)	0.9
Knee	39.58 (10.36)	0.01	9.83 (9.13)	0.1	45.83 (13.34)	0.8	23.87 (2.47)	0.9
Wrist	37.34 (8.72)	0.4	7.21 (7.50)	0.3	49.39 (12.71)	0.01	24.24 (2.04)	0.07
Ankle	46.20 (9.87)	0.00	14.8 (10.54)	0.1	53.40 (3.13)	0.00	26.06 (1.13)	0.01

- P Value

Table 5: Factors significantly associated with MSDs in past 12 month based on logistic regression				
Dependent variable	Independent variable	odd's ratio (OR)	95% (CI)*	P value
Neck pain	age	1.15	1.01-1.31	0.03
	Final RULA score	2.50	1.02-6.07	0.04
Upper back pain	BMI	1.47	1.02-2.11	0.03
	Final RULA score	3.01	1.23-7.39	0.01

*Confidence interval

Figures

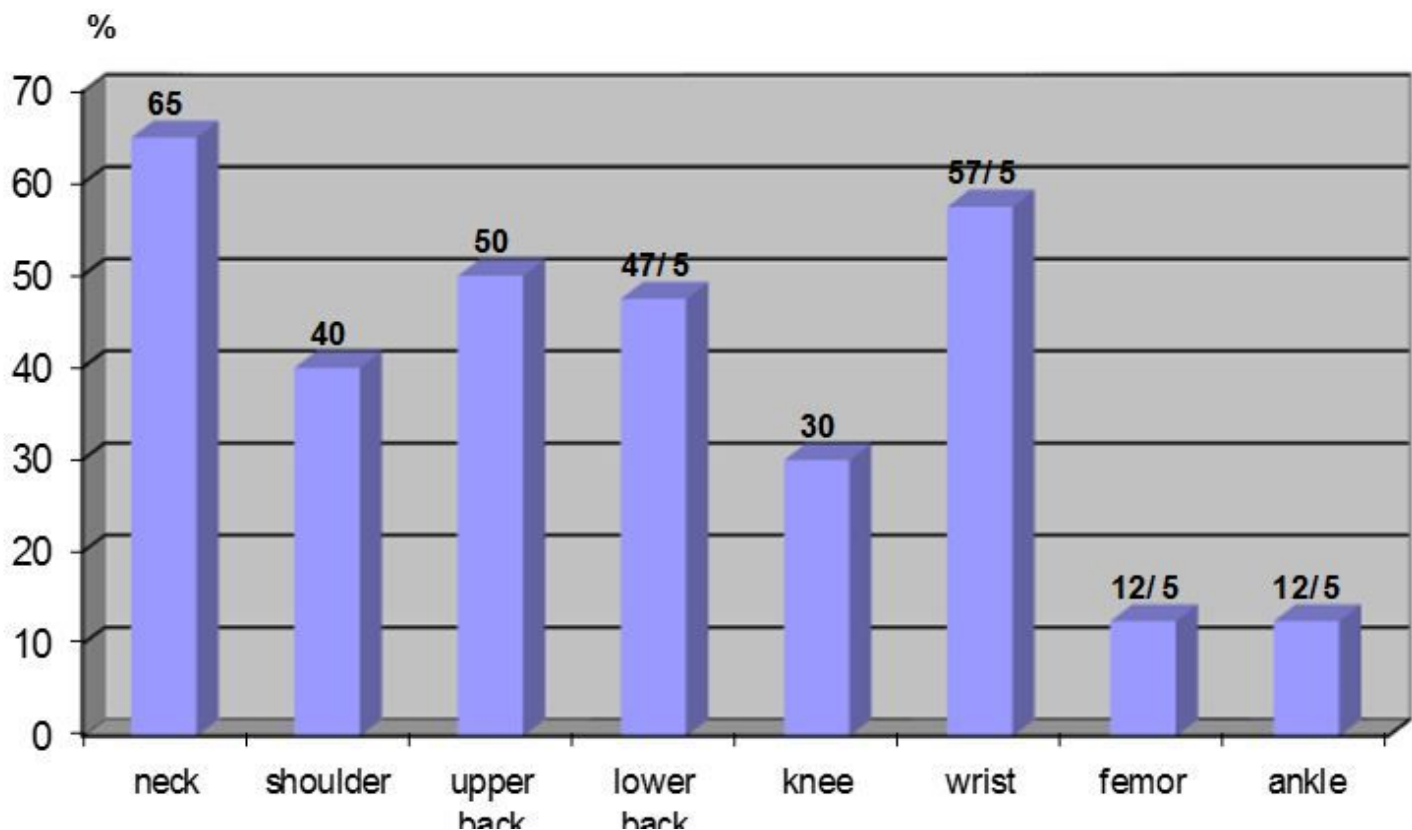


Figure 1

Prevalence of musculoskeletal disorders in study population during the past 12 months