The Prevalence of Work-Related Musculoskeletal Symptoms Among Jordanian Surgeons

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ABSTRACT

Introduction: Musculoskeletal disorders (MSDs) have become a significant issue for the profession of surgeons. This study provides a detailed examination and discussion regarding the prevalence of MSDs among Jordanian surgeons and possible causative factors.

Materials and Methods: A modified Nordic and physical discomfort questionnaire was distributed online and at the 9th International Conference of Royal Jordanian Medical Services to surgeons from several specialties with the aims of determining the level of prevalence of MSDs, causative factors related to the operating room, and the level of ergonomic awareness.

Results: Participants who sustained occupational injuries throughout their careers represented 79.2%. The most injured areas were the neck, lower back, feet, hands and wrist, eyes, and by 79.2%, 72.2%, 62.5%, respectively. Approximately 12.1% were injured while operating on infected patients. Approximately 20.3% reported their injuries to their institution

Conclusions: The rate of occupational injuries among Jordanian surgeons is high and underreported.

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Introduction

Modernisation and automation in industries and offices has introduced a myriad of dexterous hand-intensive work processes which contributed to soft-tissue injuries in the upper extremities often termed as cumulative trauma disorders. Cumulative trauma disorders have been a new-age health issue affecting millions worldwide. It has been emphasised that in all working conditions, human limits and capabilities should be studied prior to job or machine design. Ergonomics has emerged as a discipline to help solve problems arising from this incompatibility of man, machine, and the work environment. 1

Occupational injuries and hazards have gained increased attention in the last century. They are associated with much suffering and loss at the individual, community, social, and organisational levels. An injury or illness is considered work related if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a pre-existing injury or illness. 2

Different aspects related to occupational hazards have been investigated. Recent studies have concentrated on the work performed in healthcare units as it is associated with requiring considerable physical strain and causing many musculoskeletal complaints; surgeons, in particular, may be subjected to musculoskeletal disorders(MSDs) due to poor work postures during operating. 3

Practitioners of ergonomics contribute to the design and evaluation of tasks performed and products used in work situations, work environments, work systems and processes that firms set up for their employees to follow, and job functions make them compatible with the needs, abilities, and limitations of people.4

Ergonomists promotes an overall approach, in which considerations of physical, cognitive, social, organisational, environmental, and other relevant factors are taken into account.5

Domains of specialisation within the discipline of ergonomics are the following: Physical, Cognitive and Organisational Ergonomics.

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This study aims to investigate the prevalence of work-related musculoskeletal symptoms among Jordanian surgeons from various specialties and identify the characteristics of their musculoskeletal problems in relation to physical and psychological factors that might be involved in such an occupation. The study will also evaluate the level of awareness by these surgeons of ergonomic guidelines.

Materials and Methods

The methodology that was used in conducting this study consists of the following steps: development of a questionnaire based on the literature review; validation of the questionnaire content; distribution of the questionnaire to a sample of Jordanian surgeons from several specialties working in hospitals; implementation of reliability tests; analysis of statistical data using SPSS® statistical software; and utilisation and analysis of a number of observations for further investigation.

The questionnaire that was used as a data gathering technique for this study was a modified Nordic questionnaire. It was used along with a self-estimation of body discomfort questionnaire to evaluate the ongoing symptoms Jordanian surgeons are suffering from along with the contribution of operating room elements causing these symptoms.

The questionnaire was randomly distributed online as well as300 copy in papers at the 9th International Conference of the Royal Jordanian Medical Services. The total of 72 fully answered questionnaires was considered. The returned data from the questionnaires were analysed using SPSS software using proper tests to evaluate the objectives of the study.

The framework adopted in this study was developed after reviewing local and international literature of ergonomics in general, as well as literature that investigated the prevalence of MSDs among surgeons. This comprehensive literature review in this cross sectional studies that to identify the level of occupational musculoskeletal complaints among Jordanian surgeons. The literature revealed that the perceived pain was related to the following elements, which were included in the modified questionnaire structure: Table height, Monitor height and positioning, Foot pedal use, Hand tools, Specialty, Years of experience.
Each of the factors listed above involves a list of causes that contribute to the prevalence of work-related musculoskeletal complaints among surgeons from several specialties.

Results

Participants who sustained occupational injuries throughout their careers represented 79.2%. The most injured areas were the neck, lower back, feet, hands and wrist, eyes, and by 79.2%, 72.2%, 62.5%,

respectively. Approximately 12.1% were injured while operating on infected patients. Approximately 20.3% reported their injuries to their institution.

Most respondents were young specialists and residents with an age from 35–44 years, a total of 31 surgeons out of of 72 respondents (43.1%), followed by 29 respondents that were 25–34 years old (40.3%) with a P value of 0.003 and t his result was statically significant. 80.6% of respondents were male surgeons and only 19.4%were female surgeons.

Most of the surgeons who answered this questionnaire have a right dominant hand (88.9%) and right dominant leg (93.05%).

The years of experience of the respondents, as (Table I) shows, about 56.9% of respondents have 11–15 years of experience, and 25% have 5–10 years of experience, with a p of 0.552 and this means that the result is no statically significant.

Table I

Years of Exp.	N	Freq.%
Less Than 6 Months	1	1.38%
6 Months to 1 Year	4	5.55%
1–5 Years	2	2.8%
5–10 Years	18	25%
11–15 Years	41	56.9%
Greater Than 15 Years	6	8.33%

The type of procedure had also a great influence as 48.6% of respondents perform open surgery, and 51.4% perform both open and minimally invasive surgeries, 29%,2 of them were orthopaedic surgeons, 23.6% of respondents were general surgeons, 8.3% were paediatric surgeons, and 5.6% were neurosurgeons whilst 4.2% of respondents were cosmetic and reconstructive surgeons, 4.2% cardiac surgeons, 4.2% trauma surgeons, and 4.2% ophthalmologic surgeons.

Average hours for performing surgery per day according to the respondents were 6–8 hrs/day at a percentage of 50% followed by a percentage of 34.7% for an average time of 4–5 hrs/day. Most surgeons perform surgery three days per week (43.05%), two days per week (31.94%), and four days per week (23.61%) with p value of 0.005. so we can say that the duration of the procedure and the time in operation room is statically significant.

Based on (Table II), 42.9% of surgeons often experience mental exhaustion after work, and 42.9% also experience physical exhaustion after work.

Table II

Mental Stress	N	Freq.%
Never	0	0
Rarely	1	4.8%
Sometimes	6	28.6%
Often	9	42.9%
Almost Always	5	23.8%
Physical Stress	N	Freq.%
Never	0	0
Rarely	1	4.8%
Sometimes	4	19%
Often	9	42.9%
Almost Always	7	33.3%

Regarding posture, about 66.7% of surgeons perform procedures while their wrist is bent, 57.1% perform while their shoulders are raised away from their body, and 71.4% have their neck bent forward while operating. Whilst the back is usually bent forward in a C-curve shape in 52.4% of the surgeons, knees are usually kept straight in 71.4%, and the trunk position is usually in a static posture for 66.7%.Nearly 79.2% of surgeons complained of neck pain, 59.7% had shoulder pain, 62.5% hand/wrist pain, 72.2% lower back pain, and 65.3% complained of foot pain. Whilst 40.3% said they did not have any complaints about their elbows, 52.8% reported no upper back complaints, 77.8% had no complaints about their hips/thighs, and 55.6% never experienced pain in their ankles (Table III) summarizes the regional pain percentages as responders surgeon stated.

Table III

Occupational Pain in Neck	N	Freq.%
Yes	57	79.2%
No	15	20.8%
Occupational Pain in Shoulder	**N**	**Freq.%**
Yes	43	59.7%
No	29	40.3%
Occupational Pain in Elbows	**N**	**Freq.%**
Yes	19	26.4%
No	53	73.6%
Occupational Pain in Hand/Wrist	**N**	**Freq.%**
Yes	45	62.5%
No	27	37.5%
Occupational Pain in Upper Back	**N**	**Freq.%**
Yes	34	47.2%
No	38	52.8%
Occupational Pain in Lower Back	**N**	**Freq.%**
Yes	52	72.2%
No	20	27.8%
Occupational Pain in Hips/Thighs	**N**	**Freq.%**
Yes	16	22.2%
No	56	77.8%
Occupational Pain in Knees	**N**	**Freq.%**

Yes	32	44.4%
No	40	55.6%
Occupational Pain in Lower Legs	**N**	**Freq.%**
Yes	23	31.9%
No	49	68.1%
Occupational Pain in Ankles	**N**	**Freq.%**
Yes	32	44.4%
No	40	55.6%
Occupational Pain in Feet	**N**	**Freq.%**
Yes	47	65.3%
No	25	34.7%

Perceived answers on injury development (report to management, medical care, surgical care, required sick leave, or day off) demonstrated that 33.3% of the respondent's pain had developed into an injury, while only 9.72% had reported this injury to their management. About 37.5% of the respondents who perceived pain/injury had required medical care, and 11.11% had required surgical care.

The productivity and efficiency lost due to pain/injury is represented in the percentage of time that the surgeons been forced to take sick leave or a day off, which for this study was 31.9% taking a sick leave due to pain/injury and 18.05% taking a day off due to pain/injury.

The height of the operating table seemed to be acceptable for 65.3% of respondents, and most of the tables were adjustable, according to the respondents (94.4%). The level of the operating table was evenly varied between respondents: About 36.1% have the table height usually above their navel level, 33.3% at their navel level, and 30.6% below their navel level. When asked to determine whether they experience pain in the neck due to table height, only 5.6% agreed, and for experiencing pain in the shoulders, 15.3% agreed.

One of the most interesting findings in this study is the low level of awareness about ergonomic guidelines among surgeons even though they are healthcare providers. The table below shows that 59.72% of respondents were not aware of ergonomic guidelines, 26.38% were slightly aware, 8.33% were somewhat aware, and only 5.55% were aware.

Discussion

This cross sectional study gains in to the current situation of the musculoskeletal injuries and its impact among Jordanian surgeons and compares our results with information from previously conducted studies on work-related musculoskeletal symptoms among surgeons as well as categorise the causes of these symptoms.

Ergonomics can be considered as the study of workers' efficiency in their surrounding environment. It establishes a relationship between man and machine by dealing with the design of tools and machines and also the design of the work environment to achieve the best possible match between the tools, objects, and environment of the workplace and the user. 7

Previous studies addressed the problem, among them Costa and Vieira (8) who studied the hazard recognisable proof and plan of intercessions to diminish the rates of WMSDs.8

In our study we found the prevention measures where rarely applied in the operation rooms with more concentration on the operation itself rather than the safety of the personnel.

In a U.S. study by Putz-Anderson (1997), about 52% of participants complained of back pain attributed to repetitive tasks at work, and an additional 16% of participants had back pain that was attributed to discrete, acute events at work.9,10 In another study 24% of the long-term back pains reported were related to bending and lifting, working with vibrating machines, and working in awkward postures.11Responders from the other hand his study frequently reported pain in the back shoulders and complains occurred mainly during the procedure of this about 35% used analgesics and about 5% had to take a day off or reschedule their operation
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Frank Gilbreth (1916), a pioneer in the field of time and motion, observed that surgical practices and instrumentation varied greatly throughout the country leading to inefficiency and the lack of the best approach to each treatment modality. He noted that surgeons could learn more about motion study, time study, waste elimination, and scientific management from the industries than the industries could learn from the hospitals'.9,12

Despite the small number of surgeons who responded to our questioner, a positive medical history of work frequently and only 20% of them reported this injury to their institute.

Another study was conducted in Japan and Hong Kong to examine physical and psychological factors and their association with work-related musculoskeletal symptoms in the general surgery department. The research revealed a high prevalence rate of work-related musculoskeletal symptoms, mainly in the neck (82.9%), lower back (68.1%), shoulder (57.8%), and upper back (52.6%). In the results of the previously mentioned study are highly comparable to the results in our paper which means measures should be applied and work related MSD among Jordanian surgeons is a serious problem and educative and preventive measures must be applied.

The study also found that the sustained static or awkward posture, or both, during operations was perceived as the factor most commonly associated with neck symptoms by 88.9% of the respondents.13

In the years after the introduction of the first laparoscopic techniques to North American surgical audiences, MIS has become mainstream.14

It could safely be claimed that millions of patients have benefitted from the reduced preoperative morbidity, enhanced postoperative recovery, and cosmetic advantages associated with laparoscopic techniques over open surgical techniques. However we did not observe an increase number of MSD among surgeons who frequently perform minimally invasive, laparoscopic or endoscopic procedures

From the other hand our results states a small number of surgeons who perform these laparoscopic surgeries have encountered physical stress and mental strain beyond that experienced in open surgery. A similar study conducted in North America investigated the association of demographics, ergonomics, and environment and equipment with the physical symptoms of 272 laparoscopic surgeons. Approximately 86.9% of the surgeons reported physical symptoms or discomfort. The study also presented evidence that 87% of surgeons who regularly perform MISs suffer such symptoms or injuries. Overall, the study found that 20–30% reported incidence of occupational injury and 58.7% reported being slightly or not aware of ergonomic recommendations (Park, A. et al., 2010).15

In an investigation by Soueid et al. of the prevalence of pain experienced by surgeons while operating, 130 questionnaires were sent to surgical consultants (general surgeons, plastic surgeons, trauma and orthopaedic surgeons, otorhinolaryngological surgeons, and neurosurgeons) in the UK16. Among the respondents, plastic surgeons had the highest ratio of experiencing pain while operating (94%), while trauma and orthopaedic surgeons had the lowest (66%). The back and neck were the most common areas of pain, followed by the hands. But as most of our responders were orthopaedics and trauma surgeons, we cannot conclude that this results are comparable to ours as most of the on line questioners sent came back with no answer, which can be considered as one of the limitations of this study.

Nearly 80% said they had pains on a regular basis. Table height was the most common cause of pain (35%), followed by the use of microscopes (27%) and pain experienced due to standing (22%). However, only 27%

took measures to reduce their symptoms, 65% never sought any help or advice, and only one consultant had informed the occupational health department. 16

The investigations demonstrated that surgeons suffered from pain as a direct result of their work and frequently had to take breaks or sick leaves. An unexpected result of our study was the early age at which symptoms had developed, but this is supported by an earlier study done on surgeons at the Mayo Clinic that found that 16 out of 17 surgeons experienced symptoms that worsened by having started performing surgery at an early age (mean age of 35 years) which is comparable to our results.17

Another study that confirms our results of the impacts of the work related MSD that affects mainly the neck and lower back and its impact on the work progress in hospitals, an electronic Redcap survey on surgeons workplace injuries and their impact on providers, institutions, and the quality of surgical care for patients was distributed to members of the Tennessee chapter of American College of Surgeons18. The results revealed that surgeons appear to be at moderate risk of occupation-related injuries: 22% of injured surgeons missed work and 35% performed fewer operations while they were recovering from injuries. Like other study findings in this field, the most common areas of injury were back, neck, and hands. Approximately 66% of injuries were attributed to chronic causes such as strain from operating postures. The study concluded that more years of surgical experience were not associated with an increased number of injuries.18

As for orthopaedic surgery, it can be quite physical in nature, and the operating room environment may not be ergonomically ideal, which can put a high demand on the musculoskeletal system. In a study by Alqahtani et al. (2016), a modified version of a physical discomfort survey was sent via email to arthroplasty surgeons, members of the Hip Society, the international Hip Society, and the Canadian Arthroplasty Society. Approximately 66.1% of the arthroplasty surgeons reported that they had experienced a work-related injury. The most common injuries were low back pain (28%), lateral epicondylitis of the elbow (14%), shoulder tendonitis (14%), lumber disc herniation (13%), and wrist arthritis (12%). Approximately 27% of the surgeons had taken time off work because of their injury and 13% had required a surgery.1, 19 In our study we only got the results of 5 orthopaedic surgeons who perform arthroplasty on regular basis and the results that only 5% suffers from work related MSDs as their operating rooms and equipment is being weekly reviewed and adjusted, and the average of weekly precedes are 5 per week which might cause decrease of the MSDs incidence.

The prevalence of injuries found in this study is similar to one done by the same researcher in 2016 on orthopaedic paediatric surgeons who were members of the Paediatric Orthopaedic Society of North America using a modified physical discomfort survey sent via email. Overall, a high prevalence of surgeons (67%) who completed the survey reported a work-related musculoskeletal injury during their practice. About 26% required a surgical treatment for their injury, and more than 31% required time off work as a consequence of the injury. The study also found that increasing age, increasing number of years in practice, and requirement for surgical management of the injury were associated with an increased number of reported injuries and the need to take time off work due to the sustained injury. The author suggested improved ergonomics in the operating room and more implementation of surgeon educational programmes, including recommendations for the distribution of the workload among assistants in the operating theatre and implementing micro-breaks during long operative procedures.3, 20

In another study involving the orthopaedics specialty, an electronic survey was sent to all paediatric orthopaedic surgeons in Saudi Arabia to identify the rate of occupational injuries and obtain other relevant information. Approximately 82.5% of participants had sustained occupational injuries throughout their careers, and 30.3% had reported their injuries to their institution. The surveyed population was relatively small, but the occupational injuries were high and the majority had not reported their injuries to their institution. The author suggested that educational programmes and courses about occupational injuries should be provided and protective ergonomic measures should be implemented in all hospitals and healthcare institutions. 2, 21

In another study, the researchers used a Rapid Upper Limb Assessment to evaluate the body positions, which resulted in a score of 7 in a 7-point scale, which reflects high risk. This score meant that the working conditions require investigation and immediate change due to a high risk of occurrence of WMSDs for surgeons.22

To investigate possible solutions to minimise the risk on surgeons, researchers of one study tried to incorporate intraoperative micro-breaks during operations. After the implementation of micro-breaks and exercise, without harming the safety of the patient, 87% of surgeons wanted to incorporate the micro-breaks with exercises into their operating room routine. About 34% of surgeons reported an increased mental focus and 57% reported an improved physical performance. The author suggested that more data needs to be collected over longer intervention periods and different procedures with longer or more complex surgeries.23

An earlier prospective experimental study evaluated the effectiveness of micro-pauses to prevent muscular fatigue and its deleterious effect on surgeons during prolonged surgical procedures. The study concluded that micro-pauses prevented almost completely the effects of fatigue associated with surgery. The research involved the implementation of a 20-second break every 20 minutes for 16 surgeons who were tested three times: once in a control situation before any surgery, and twice after a prolonged, reproducible operation (at least two hours)—one of these with formal micro-pauses and the other without. Muscular fatigue was tested by having the surgeon hold a 2.5-kg weight as long as possible with a stretched arm. Accuracy was evaluated with a device to measure the mistakes made when following a predetermined path on a board and discomfort was measured by a visual analogue scale.24

Whether open or laparoscopic surgery is performed, most procedures are conducted in a standing position for long hours, which induces musculoskeletal problems. To solve these problems, a prototype was developed for a free-standing posture-support device that can be used to reduce the stress placed on the lower half of the surgeon's body and facilitate the performance of surgery. It is a simple non-electric device, referred to as a surgical knee rest (SKR). To evaluate its effectiveness, a surface electromyography study was conducted to measure and compare occupational lower-limb stress in laparoscopic surgeons during the use and non-use of an SKR. The device consists primarily of a curved, 9-mm stainless-steel plate that weighs 8.5 kg. The plate is fastened to a portable stand that rests on the floor. The SKR does not require installation or a power source, and there are no specific user restrictions or complicated user instructions. The advantage of the design is that the SKR can be used in a surgical setting, and it does not prevent the surgeon from using his or her dominant foot for pedal control because it can be used for one or both knee. The surgeon can bend his or her knee(s) slightly and about a third of the weight-bearing load is transferred from the rear foot to the tibia. A study was done on five healthy consultant colorectal male surgeons, in which a total of 10 laparoscopic surgeries were performed, two curative resections of colorectal cancer per participating surgeon. Five of the surgeries were performed without the use of an SKR for the acquisition of control data, and five were performed with the use of an SKR for experimental data. All operations were performed in a standing position. Some of the participants stated that they experienced much less lower back strain when using the SKR and none stated that they did not like using it. Thus, the use of the SKR was shown to decrease surgeons' physical stress.25, 26

A cross-sectional study was conducted in three cities in Iran at 15 large hospitals to evaluate the effect of physical, psychosocial, and individual factors on the presence of musculoskeletal symptoms among surgeons based on the standardised Nordic Musculoskeletal Questionnaire. The prevalence was relatively high in knees (48.7%), neck (45.8%), low back (42.3%), and shoulder (40.1%). The study findings highlighted the importance of individual and work-related (both physical and psychological) factors in the development of musculoskeletal symptoms among surgeons 10, 26

Operating room and instruments design have traditionally favoured surgeons who are taller and who possess hands that are generally large and strong. In a study that hypothesised that women may be experiencing more ergonomic stress due to these reasons, a 23-item Web-based survey was emailed to 2,000 laparoscopic surgeons and fellows currently practicing in Baltimore in the US. The survey focussed on four categories:

demographics, physical symptoms, ergonomics, and environment/equipment. Among the respondents, 17% were female. This percentage of women was significantly younger, shorter, and had smaller glove sizes and fewer years of practice than the men surveyed. The analysis revealed that female surgeons were more likely to receive treatment for their hand, which includes the wrists, thumbs, and fingers. 27 A comparison between men and women with the same glove size revealed that women with a larger glove size (7–8.5) reported more cases of treatment for their hands than men of the same glove size. Women who wore a smaller size (5.5–6.5) of surgical glove reported significantly more cases of discomfort in their shoulder area (neck, shoulder, upper back) than men who wore the same size. 15, 28

Conclusion

We concluded that the rate of occupational injuries among Jordanian surgeons is high and under reported. Although most studies concentrate on the importance of patient safety and thus the quality of the health care system, the surgeon's safety is also considered an integral part of this system's quality. This study highlights a high prevalence of musculoskeletal work-related injuries among Jordanian surgeons and indicates the need for the identification of preventive measures directed toward improving the operative surgical environment and work ergonomics for the surgeons.

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