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Correlation between Work-Related Musculoskeletal Disorders and Medical Errors in Surgical Technologists of Mazandaran Educational Hospitals, Iran (2019)

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Abstract

Background: Work-related musculoskeletal disorders (WMSDs) are among the most common occupational problems facing surgical technologists in the operating room, which could be associated with high costs and a reduction in the healthcare quality. The operating room could be the source of various types of surgical errors caused by numerous invasive procedures. This study aimed to investigate the correlation between musculoskeletal disorders and medical errors in surgical technologists.

Materials and Methods: This descriptive study was carried out on 201 operating room surgical technologists working at Sari City hospitals. The samples were selected by convenience sampling. Data collection instruments included the Nordic Musculoskeletal Questionnaire and the operating room-related medical errors questionnaire. Data were analyzed by SPSS software and the Pearson's correlation model.

Results: The results showed that disorders in the lumbar and back regions were the most common disorders among surgical technologists with the prevalence of 51.2%. In addition, there was a significant correlation between medical errors and WMSDs in the wrist and knee regions ($P < 0.05$). There was also a significant relationship between gender, BMI, marital status, regular exercise, and weekly working hours with WMSDs, as well as between medical errors and gender ($P < 0.05$).

Conclusion: The prevalence of WMSDs and medical errors was high among surgical technologists; therefore, given the high-risk environment of the operating room, proper measures must be adopted to reduce WMSDs and medical errors.

Keywords: Ergonomics, Medical Errors, Surgery, Operating Room.

Introduction

Although work is essential for the wellbeing and development of a community in social and economic contexts, the work environment and work qualification could cause many problems, with one of which being work-related physical disorders that lower work efficiency. This could be mainly due to the low level of occupational health and education among individuals [1].

By definition, musculoskeletal disorders include disorders of muscles, tendons, sheaths, peripheral nerves, joints, bones, ligaments, and blood vessels, which are caused by repeated stress over

time, or are the result of an immediate or acute trauma, such as slipping and falling [2, 3].

Work-related musculoskeletal injuries and damages are very common. According to the Occupational Safety and Health Administration, a cumulative injury is one or more complaints, such as pain, paresthesia, tingling, falling asleep, stiffness, or movement restriction in one of the joints of the body, which takes longer than one week or is repeated at least once a month during the last year. This definition would apply, if there were no injuries or damage to the joints in question, the symptoms were clearly related to the person's current occupation, and the symptoms were evidenced by the person. Such injuries would be substantiated by other means, such as requesting treatment and medical counseling, or quitting daycare activities [4].

Work-related musculoskeletal disorders are among the most important occupational health issues and among the most common causes of occupational injuries and disabilities in developing countries. These disorders result in the loss of labor as well as an increase in costs and human injuries, being among the most challenging issues ergonomists face all over the world [5-7].

Musculoskeletal disorders are the second-leading cause of sickness absence after respiratory problems in the short term (less than two weeks) [8]. These disorders have been a major cause of work-related absences of more than two weeks in Norway. According to a study in Sweden, musculoskeletal disorders were the most costly disorders in the healthcare system [3].

In the US and Canada, 1.3% and 2.4% of the gross national income are spent on indirect costs of musculoskeletal disorders, respectively [8]. In a study, musculoskeletal disorders accounted for 7% of total diseases of the society, 48% of all occupational diseases, 19% of hospitalizations, and 14% of referrals to physicians [9].

In the United States, musculoskeletal disorders have caused over 600,000 working hours to be lost and have cost from 45 to 54 billion dollars [10]. Healthcare workers are at a higher risk of developing musculoskeletal disorders than workers in manufacturing, construction, and mining industries [11].

Nursing jobs, due to the nature of the work, are among occupations in which work-related musculoskeletal disorders are more prevalent than in others [12]. According to nurses, the moving and lifting of patients are the most stressful parts of their job [11]. While most research focuses on hospital nurses, there is limited information on musculoskeletal disorders in more specialized groups of hospital staff, such as operating room nurses [13].

In the operating room environment, apart from risk factors, such as inappropriate postures, continuous and repetitive movements, lifting and conveying heavy objects, holding equipment, such as retractors during surgical procedures, aging, and inadequate sleep, other factors, such as bed height and monitor positioning increase the risk of postural injuries to the neck, shoulders, and the waist in operating room personnel [7, 13-15].

It was estimated in 2008 that more than 50% of musculoskeletal disorders in the United States were related to occupational injuries caused by patient transport [16]. A total of 66.1% of the operating room staff in Switzerland suffer from musculoskeletal disorders, with 52.7% and 38.4% of which affecting the lumbar and cervical regions, respectively [15].

Medical errors are referred to as the failure to plan ahead or the use of a wrong pattern for achieving the desired goal [17]. Medical errors and their adverse effects are among the major issues discussed in the field of healthcare worldwide [18], which dramatically affect patient safety. However, the method of reducing the severity and frequency of medical errors is an important issue in the field of healthcare [19]. According to the American Medical Association, many patients die every year due to medical errors [20].

At the same time, medical errors made by medical staff due to clinical negligence could potentially lead to litigation by patients and their family [21]. When a medical error occurs, regardless of whether the patient is harmed or not, this issue must be assessed to determine the factors leading to such an event. One of the major components of such an assessment could be the determination of human factors associated with the errors [18]. However, research shows that many medical errors and misconducts are not reported, with this being one of the major concerns in the health system throughout the world [22].

Numerous studies have been conducted on the prevalence and influencing factors of musculoskeletal disorders in healthcare personnel, especially in nurses; however, few studies have been conducted in this field among specialized nurses in the operating room. In addition, the relationship between this type of disorder and medical errors specific to surgical technologists in the operating room is new and innovative. Accordingly, the present study aims to find the correlation between work-related musculoskeletal disorders and specific medical errors by surgical technologists in the operating room at Sari teaching hospitals in 2019.

Materials and Methods

This study surveys self-reports of work-related musculoskeletal disorders and medical errors of operating room surgical technologists working at teaching hospitals of Sari City in November 2019. The study population included operating room surgical technologists working at 5 teaching hospitals in Sari City. A total of 250 questionnaires were distributed, with 201 of them returned, which accounted for a response rate of 80.4%.

The inclusion criteria of this study were having at least one year of work experience, having no history of surgery in the musculoskeletal system, having no accident leading to injuries to the body, having no second job, and being willing to participate in the study.

The questionnaires contained information on 3 categories. The first part of the questionnaires included questions about demographic information, such age, gender, marital status, education level, type of work system, regular exercise (yes/no), work hours per week (less than 45 hours, 45 hours, and more than 45 hours), and BMI.

The second or symptomatic part of the questionnaires included questions about musculoskeletal symptoms in 9 anatomic regions according to the Nordic musculoskeletal questionnaire (23), including the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet (Fig.1).

The self-reported musculoskeletal complaints were collected through the standardized Nordic questionnaire for musculoskeletal symptoms, which had been translated into Persian [24]. All items of the questionnaire had acceptable face validity (0.82); in addition, the acceptable reliability [0.7 (0.87-1)] of this questionnaire was confirmed in various scientific studies [25, 26]. In the present study, the face and content validity of this questionnaire was confirmed by 10 faculty members of Mazandaran University of Medical Sciences, with its reliability verified with the Cronbach's alpha coefficient of 0.90.

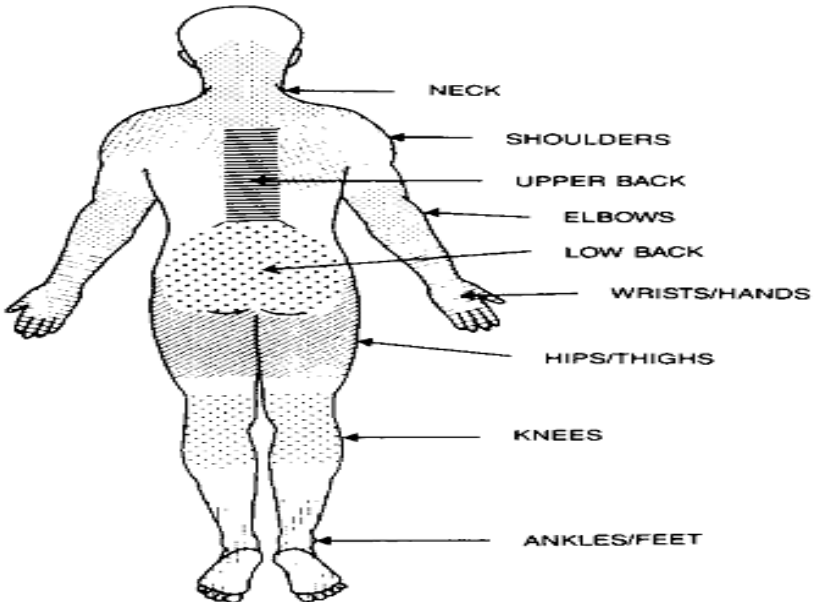

Fig. 1. Body sites; standardized Nordic questionnaire for musculoskeletal symptoms

The third part of the questionnaire included questions about medical errors of surgical technologists (16 items), with the items of the highest frequency selected by accepted units as the results of the study. It is worth noting that this questionnaire is a modified form of the nursing errors questionnaire used in the operating room, which was developed by Azarbad et al [27]. In addition, it includes the types of error (15 items), the causes of error (24 items), as well as questions about the reasons for not reporting the error (17 items). The frequent items of "medical errors by operating room surgical technologists" designed by Chard (28) were used in Iran by Tayfouri and Valiei [29], and its reliability was reported with a Cronbach's alpha coefficient of 0.89. In this study, the face and content validity of this questionnaire was confirmed by 10 faculty members of Mazandaran University of Medical Sciences, and its reliability was reported with the Cronbach's alpha coefficient of 0.88.

Data were analyzed by SPSS Statistics 20 using descriptive statistics, the one-way ANOVA, a t-test (student's t-test), and the Pearson's correlation coefficient test at a significance level of 0.05. In addition, to verify data normalization and to adjust the effects of confounding variables on the main variables, Kolmogorov-Smirnov and Partial Correlation tests were utilized, respectively.

Results

The mean age of the surgical technologists who participated in this study was 32.2 ± 8.6 years, with the minimum and maximum of 23 of 60 years, respectively. In addition, an average service experience of 9.1 ± 8.7 years with the minimum and maximum of 1 and 41 years, respectively, as well as the median service experience of 6 years were recorded for them. Besides, the mean BMI of the participants in this study was 24 ± 1/5, with the mean BMI of the males and females having been 23.25 and 27.05, respectively. Table 1 shows the frequency distribution of the demographic variables in the subjects.

Table 1. Frequency distribution of demographic variables in surgical technologists (n = 201) working at Sari educational hospitals in 2019

Variable		Frequency	Percentage
Gender	Male	70	34.8
	Female	121	65.2
Marital status	Single	89	44.3
	Married	112	55.7
Education level	Associate degree	26	12.9
	B.Sc.	141	70.2
	M.Sc.	34	16.9
Type of work system	Fixed shift	44	21.9
	Rotating shift	157	78.1
Doing regular exercise	Yes	83	41.3
	No	118	58.7
Work hours per week	Less than 45 hours	34	16.9
	45 hours	61	30.3
	More than 45 hours	106	52.8

Musculoskeletal disorders in the lumbar (or lower back) region were reported to be the most prevalent disorders with 51.2%, followed by knees with 47.3%, the neck and feet both with the rates of 30.8%, respectively during the last year, with the results being listed in full in Table 2.

Table 2. Frequency (percentage) of musculoskeletal disorders in surgical technologists working at Sari educational hospitals in 2019

Region	Frequency	Percentage
Neck	62	30.8
Shoulders	45	22.4
Elbows	35	17.4
Wrists	58	28.9
Back	103	51.2
Lumbar	103	51.2
Thighs	28	13.9
Knees	95	47.3
Feet	62	30.8

Pearson's correlation coefficient results for the relationship between demographic variables and nine musculoskeletal areas of the body show a significant relationship between gender and wrist pain (P=0.011) (r=0.180), marital status and elbow pain (P=0.015) (r= -0.172), marital status and knee pain (P=0.045) (r= -0.142), doing regular exercise and knee pain (P= 0.038) (r= -0.146), working hours per week and knee pain (P= 0.025) (r=-0.158), as well as BMI and foot pain (p= 0.011) (r= -0.179). Table 3 shows full results for the correlation.

Table 3. Pearson's correlation between demographic variables and musculoskeletal regions

Demographic variables / Musculoskeletal regions	Neck P-value (r)	Shoulders P-value (r)	Elbows P value (r)	Wrists P-value (r)	Back P-value (r)	Lumbar P-value (r)	Thighs P-value (r)	Knees P-value (r)	Feet P-value (r)
Age	0.335 (-0.068)	0.082 (-0.123)	0.307 (-0.072)	0.320 (-0.071)	0.336 (0.068)	0.261 (0.080)	0.483 (-0.050)	0.801 (0.018)	0.476 (0.051)
Gender	0.850 (-0.013)	0.555 (-0.042)	0.753 (0.022)	0.011* (0.180)	0.740 (0.024)	0.740 (0.024)	0.456 (-0.053)	0.072 (-0.127)	0.252 (-0.081)
Marital status	0.453 (-0.053)	0.321 (-0.070)	0.015* (-0.172)	0.921 (0.007)	0.388 (0.068)	0.388 (0.068)	0.165 (-0.098)	0.045* (-0.142)	0.436 (0.055)
Educational level	0.212 (0.088)	0.241 (0.083)	0.249 (0.082)	0.220 (0.087)	0.128 (-0.108)	0.128 (-0.108)	0.679 (0.029)	0.329 (0.069)	0.683 (0.029)
System of working	0.834 (-0.015)	0.199 (0.091)	0.233 (-0.084)	0.525 (-0.045)	0.387 (-0.061)	0.387 (-0.061)	0.950 (-0.004)	0.342 (-0.067)	0.834 (-0.015)
Doing regular exercise	0.902 (0.009)	0.377 (-0.063)	0.865 (-0.012)	0.988 (0.001)	0.314 (-0.071)	0.314 (-0.071)	0.316 (0.071)	0.038* (-0.146)	0.666 (0.031)
Working hours per Week	0.808 (0.017)	0.124 (-0.109)	0.534 (0.414)	0.802 (-0.018)	0.342 (-0.067)	0.342 (-0.067)	0.586 (0.039)	0.025* (-0.158)	0.574 (-0.040)
BMI	0.187 (-0.094)	0.445 (-0.054)	0.547 (-0.043)	0.697 (-0.028)	0.847 (-0.014)	0.835 (-0.015)	0.509 (-0.047)	0.752 (-0.022)	0.011* (-0.179)

*P<0.05

According to the results of this study, the highest error rates were related to being inattentive to sterile technique (70.6%), lack of proper equipment (69.7%), incorrect counting of surgical gauzes (63.7%), as well as incorrect counting of surgical instruments (57.2%) (Table 4).

Table 4. Frequency of medical errors from the perspective of surgical technologists working at Sari educational hospitals in 2019

Component	Agree		No idea		Disagree	
Expression	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
1. Uncertainty about the site of surgery	97	48.3	35	17.4	68	34.3
2.Uncertainty about the direction of surgery (right or left in bilateral surgeries)	106	52.7	30	14.9	65	32.3
3. Improper fixing of electrosurgical pads	89	44.3	41	20.4	71	35.3
4. Improper patient position	96	47.8	52	25.9	53	26.4
5. Wrong dosage of medications	96	47.8	55	27.4	50	24.9
6. Inaccurate counting of surgical gauzes	128	63.7	15	7.5	58	28.9
7. Inaccurate counting of surgical instruments	115	57.2	25	12.4	61	30.3
8. Disregard for sterile technique	142	70.6	17	8.5	42	20.9
9. Misuse of equipment	115	57.2	41	20.4	45	22.4
10. Lack of proper equipment	140	69.7	35	17.4	26	12.9
11. Reaction to blood or blood products	96	47.8	55	27.4	50	24.9
12. Incorrect surgical site	94	46.8	35	17.4	72	35.8
13. Incorrect draping of surgical site	94	46.8	33	16.4	74	36.8
14. Unawareness of patient allergies	100	49.8	52	25.9	49	24.4
15. Failure to recognize the right patient	95	47.3	34	16.9	72	35.8
16. Retained foreign object at the surgical site	105	52.2	26	12.9	70	34.8

According to the results of the Pearson's correlation coefficient between the total score of medical errors and demographic variables, there was a significant relationship between medical errors and gender (P= 0.021) (r= -0.162) as well as the level of education (P= 0.036) (r= -0.148). The results are fully listed in Table 5.

Table 5. Pearson's correlation between demographic variables and medical errors

Demographic variables	Age	Gender	Marital status	Educational level	System of working	Doing regular exercise	Working hours per week	BMI
Medical errors	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)
Medical errors	0.587 (0.039)	0.021* (-0.162)	0.855 (-0.013)	0.036* (-0.148)	0.851 (-0.013)	0.846 (-0.014)	0.866 (-0.010)	0.355 (0.068)

*P<0.05

In terms of the correlation between the total score of medical errors and the nine musculoskeletal areas of the body, the results of the Pearson's correlation coefficient showed a significant relationship between the total score of medical errors and hand (p= 0.007) (r= -0.190) as well as knee pain (p= 0.042) (r= -0.035). The results are fully listed in Table 6.

Table 6. Pearson's correlation between musculoskeletal regions and medical errors

Musculoskeletal regions	Neck	Shoulders	Elbows	Hands	Back	Lumbar	Thighs	Knees	Foot
Medical errors	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)	P-value (r)
Medical errors	0.918 (0.007)	0.988 (-0.001)	0.911 (0.008)	0.007* (-0.190)	0.282 (0.076)	0.235 (0.084)	0.627 (-0.035)	0.042* (0.144)	0.383 (-0.062)

*P<0.05

Discussion

Musculoskeletal disorders are among the most important ergonomic outcomes in the contemporary world, which are caused by various risk factors [30]. Musculoskeletal disorders are prevalent among operating room personnel [31]. In this study, the vast majority of the study population had experienced some work-related musculoskeletal disorders during the past 12 months. Accordingly, lower back and lumbar disorders were the most prevalent problems. This finding is consistent with those of Sheikhzadeh [31], Keriri [32], and Nützi [15] on the lower back and lumbar pain prevalence in operating room surgical technologists, which amounted to 51.2%, and with other studies conducted on healthcare workers [33, 34). Bos et al [35] and Nützi [15] found higher prevalence of lower back and lumbar pain in the operating room surgical technologists at 76.6% and 52.7%, respectively. This finding could be due to different assignments as well as the variety of tasks and activities, such as changing patient positions in the operating room, inappropriate postures, repeated movements, lifting and transporting heavy equipment, such as retractors during surgical procedures, incongruity between bed height at the operating room and technologists' height, as well as the inappropriate position of the monitor in the operating room. These factors increase the risk of postural damage to the neck, shoulders, and back in the staff. To prevent it from happening, ergonomic and safety principles must be adhered to in a variety of postures by this group of healthcare workers. In the studies conducted by Marras and Ferguson [36] as well as Choobineh [13], individual factors were found out to be effective in developing musculoskeletal disorders. In this study, a significant relationship was observed between some factors, such as gender, BMI, regular exercise, and working hours per week with musculoskeletal disorders. Accordingly, the incidence of these disorders was reported to be more in women than in men. This finding was consistent with those of Zarea [37] and Raeisi [8], which could be attributed to the relatively lower muscle strength in women than in men, thereby being more prone to damage to their musculoskeletal system. It should be noted that the average BMI in women was higher than that in men, which was on the verge of obesity, having been one of the main causes of musculoskeletal injuries. In addition, people with higher BMI suffered more from disturbances in the leg, with the main reason of which being that standing on one's feet for long in the operating room could increase pressure on the feet in these people. The results of this study, in this regard, were consistent with those of Darby [38], Dadarkhah [39], and Nasiry Zarrin Ghabaee [40]. In addition, there was a significant relationship between regular exercise and musculoskeletal disorders. This could be due to the fact that people doing regular exercise have higher physical fitness and muscle strength,

thereby inhibiting musculoskeletal disorders; this finding was consistent with those of Haghdoost's study [6].

Furthermore, there was a significant relationship between weekly working hours and musculoskeletal disorders. This could be due to the fact that, because of the high workload in the operating room, more time is spent in this place, thereby intensifying musculoskeletal disorders in surgical technologists. This finding was in line with those of Rokni's study [10]. The operating room is one of the riskiest parts of the hospital, in which medical errors could inflict serious injuries to patients. Medical errors are defined as negligence in providing services or committing a mistake in planning or execution phases, which potentially or actually leads to an unintended consequence [41]. If these errors occur frequently, they will endanger patients' life, increase hospital stay, and impose additional costs on patients and their family; therefore, minimizing these errors is one of the major goals of healthcare organizations. Minimizing medical errors, as one of the main pillars of clinical governance in the field of risk management, is pretty significant. Accordingly, since the cause of the majority of errors is functional, the study of their occurrence process is of significant importance. In this study, the most common cause of medical errors in surgical technologists was disregard for sterile technique, having been consistent with the study of Azarbad et al [27]. The research community in this study was operating room surgical technologists, yet operating room students were selected as the research community in the study of Azarbad et al. In a study by Darabi et al [42] on errors made in the operating room at Imam Reza hospital in Kermanshah City, electrocautery burns were reported as the major medical error in the operating room. In the study of Stomberg et al [30], it was suggested that the retention of surgical items in the body of treated patients could lead to dangerous complications in patients, including pain, abscess, infection, and bowel obstruction. Each of these complications could increase patient length of stay and endanger patient safety. In this study, there was a significant relationship between medical errors and musculoskeletal disorders in the wrist and knee regions. In other words, with an increase in disturbances in the wrist and knee regions, the probability of committing medical errors increased among operating room surgical technologists. These errors could have been mainly caused by improper postures, the use of manual retractors at most hospitals, as well as the use of inappropriate and old surgical instruments that could damage the wrist.

In addition, the sensory focus of operating room surgical technologists has been diminished because of long-term standing, lifting, and handling of heavy objects that cause pain in the knee region, thereby leading to such errors. In a study conducted by Shamsali et al [43], demographic factors were considered effective in the occurrence of medical errors. In the mentioned study, a significant relationship was observed between gender and the level of education with the occurrence of medical errors. The results of this study showed that women were less likely than men to commit medical errors, which could be due to the delicate and sensitive nature of women in performing their duties. This finding of the study was in line with that of the study of Shamsali [43] and Azarbad [27]. At the same time, the incidence of medical errors had a significant negative relationship with the level of education among surgical technologists so that people with higher levels of education committed fewer errors. This could be primarily attributed to the increase in the level of information and self-awareness among individuals, and secondly to their job position where people were more engaged in supervisory tasks than in directly getting involved in surgery.

Conclusion

In this study, it was found that musculoskeletal disorders in the wrist and lumbar region in operating room surgical technologists were significantly associated with medical errors in these. Therefore it is suggested that the principles of ergonomics and maintaining the physical health of surgical technologists considered from the beginning, and teaching the principles of ergonomics as a course for operating room surgical technology students, as well as the operating room surgical technologists' continuous training. Also, operating room managers can help to increase the satisfaction of operating room surgical technologists, improve and provide medical services and improve patient safety by creating suitable work environment and adopting strategies to identify, reduce and eliminate effective factors in creating and aggravating musculoskeletal disorders.

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