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The effect of the ergonomic intervention program on work-related musculoskeletal disorders in healthcare professionals

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ABSTRACT

Introduction: Work-related musculoskeletal disorders (WRMSDs) are the most common work-related disorders and describe a wide range of degenerative and inflammatory states that affect blood vessels, peripheral nerves, bones, joints, ligaments, tendons, and muscles. Healthcare as a special sector has almost the highest prevalence of WRMSDs in the world, far ahead of construction, mining, and manufacturing. Studies conducted in the EU and the USA indicate that health-care professionals most often have a problem with the lower back between 50% and 57% of cases, resulting in an average loss of more than 7 working days during 1 year.

Methods: This study included 177 health professionals of both genders who are actively involved in the provision of health-care services. The study was conducted in the Public Health Center of Sarajevo Canton, which provides primary and specialist-consultative healthcare services. The study was designed as a prospective, longitudinal, interventional, and descriptive-analytical that included all respondents who met the inclusion criteria. The instruments used in the study are the standardized Dutch Musculoskeletal Discomfort Questionnaire, modified according to our study, the standardized work ability index, and the ergonomic intervention program (EIP).

Results: The highest frequency of work-related MKDs in health-care professionals before and after implementation of the EIP was in the neck area (83.1% before, 64.9% after), in the upper back region (71.8% before, 56.5 % after) and in the lower back region (68.4% before, 55.9% after). The average score of the working ability index before the introduction of the EIP was 35.44 ± 8.59, while after the implementation of the EIP it increased statistically significantly and amounted to 38.40 ± 7.30.

Conclusion: The EIP influenced the reduction of the MKDs frequency caused by work, and increased the working capacity of health-care professionals.

Keywords: Ergonomic intervention program; work-related musculoskeletal disorders; healthcare professionals

INTRODUCTION

Work-related musculoskeletal disorders (WRMSDs) are the most common work-related disorders and describe a wide range of degenerative and inflammatory states that affect blood vessels, peripheral nerves, bones, joints, ligaments, tendons, and muscles (1,2). WRMSDs usually affect the back, neck, shoulders, and upper limbs but can also affect the lower limbs. They include any damage or disorder of joints as well as changes in soft tissue structures. Pain is the most common symptom associated with WRMSDs. In some cases, joint stiffness, muscle tension, redness, and swelling of the affected area may occur. Symptoms can range from very mild to severe (3). Healthcare as a special sector has almost the highest prevalence of WRMSDs in the world, far ahead of construction, mining, and manufacturing. Studies conducted in the EU and the USA indicate that health-care professionals most often have a problem with the lower back between 50% to 57% of cases, resulting in an average loss of more than seven working days during 1 year. In 2017 alone, 582,800 healthcare professionals reported some form of WRMSDs (4). In addition to the negative impacts of WRMSDs on the quality of life, they also have economic consequences that can amount to as much as 2% of GDP in the EU countries (5).

METHODS

This study included 177 health professionals of both genders who are actively involved in the provision of health-care

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services. The study was conducted in the Public Health Center of Sarajevo Canton, which provides primary and specialist-consultative healthcare services. Inclusion criteria were respondents over 18 years of age, who have at least 1 year of work experience, who actively participate in providing services to patients, respondents who spend at least 1/2 of their working time with patients, and respondents who signed consent to participate in the study.

The study was designed as a prospective, longitudinal, interventional, and descriptive-analytical that included all respondents who met the inclusion criteria. The instruments used in the study are the standardized Dutch Musculoskeletal Discomfort Questionnaire, modified according to our study, the standardized work ability index (WAI), and the ergonomic intervention program (EIP).

The EIP after data collection and processing consisted of holding a series of expert lectures by departments within the Public Health Center of Sarajevo Canton, where all participants were offered measures aimed at improving working conditions, increasing work ability, and reducing, or preventing musculoskeletal disorders.

The EIP included:

(a) Education on ergonomic risk factors in the workplace as well as health protection measures at work, with the aim of promoting the employees' health;
(b) Familiarizing with the positive effect of short breaks during working hours on physical and mental health;
(c) Education on the regular application of a program of preventive and therapeutic exercises with the aim of preventing/reducing pain and discomfort;
(d) Familiarizing with the positive impact of recreational activities outside the workplace.

As part of the training, all respondents were introduced to the correct way of performing preventive-therapeutic exercises through a practical demonstration. Furthermore, all respondents were given a leaflet with an adequate program of preventive and therapeutic exercises. The recommendation was that the exercises should be done at least 5 times a day for 3-5 min over a period of 3 months and that the first exercise, or the first series of exercises, should be in the morning immediately after waking up, getting out of bed, and the other series of exercises should be done distributed during working hours (at regular time intervals between work with patients, or between work tasks).

Data were entered in the EpiData program version 3.1 (Center for disease Control, Washington, USA) and imported into the IBM Statistical Package for the Social Sciences SPSS version 23.0 (Chicago, Illinois, USA) in which the integrity check and data analysis was performed.

Analysis of categorical variables was performed using Pearson's Chi-square test (χ^2) or Fisher's exact probability test. The arithmetic mean with standard deviation was used to display the mean value and measures of dispersion, and the parametric Student's t-test was used to compare continuous variables. The threshold of statistical significance was set at the conventional level of $\alpha = 0.05$ or at the confidence level of 95%.

RESULTS

The analysis of the gender structure revealed that there were significantly more female respondents in the sample, 145 (81.9%) compared to 32 (18.1%) male respondents, which was confirmed by statistical analysis using Chi-square test and indicated that there is a statistically significant deviation in the gender structure of the respondents from the expected distribution ($\chi^2 = 12.141$; $p = 0.0001$).

The average age of the respondents in the sample was 46.78 ± 10.31 years, and the median was 48 years, with the youngest respondent at the age of 20 and the oldest at the age of 65.

The analysis of the occupations of the respondents included in this study revealed that the largest number of respondents are nurses – medical technicians 29.4%, then physicians 15.8% and graduated nurses – medical technicians 14.7%, while the smallest number are higher physiotherapists and graduated engineers of medical-laboratory diagnostics with 0.6%.

The analysis of respondents according to the years of service and working hours revealed that the respondents performed their current job for an average of 18.98 ± 10.95 years, with the shortest length of service of 1 year and the longest of 40 years. On average, the respondents work for 37.88 ± 3.01 h/week. The shortest reported weekly working time was 17.5 h, while the longest was 50 h/week.

An analysis of the presence of pain/discomfort in the neck, upper and lower back before implementing the EIP found that the most affected area is the neck, then the upper back, and in third place the lower back. After the implementation of the EIP, there is a statistically significant reduction in the presence of pain/discomfort in all three areas (Table 1).

By analyzing the presence of pain/discomfort in the area of the upper limbs before the implementation of the EIP, it was determined that the most frequently affected in the upper extremities area are the shoulders, then the wrists, and in third place the elbows. After the implementation of the EIP, there is a statistically significant reduction in the presence of pain/discomfort in all three regions of the upper limbs (Table 2).

The analysis of the presence of pain/discomfort in the area of the lower limbs before the implementation of the EIP determined that the most affected in the lower extremities area are the knees, then the hips, and in third place the area of the ankle joints. After the implementation of the EIP, there is a statistically significant reduction in the presence

TABLE 1. Presence of pain/discomfort in the neck, upper, and lower back region before and after the implemented ergonomic intervention program

Region	Yes	No	Significance
Neck			
Before	147 (83.1%)	30 (16.9%)	χ^2=27.322; p=0.001
After	115 (64.9%)	62 (35.1%)	
Upper back			
Before	127 (71.8%)	50 (28.2%)	χ^2=16.119; p=0.001
After	100 (56.5%)	77 (43.5%)	
Lower back			
Before	121 (68.4%)	56 (31.6%)	χ^2=20.214; p=0.0001
After	99 (55.9%)	78 (44.1%)	

of pain/discomfort in all regions of the lower limbs, except in the right ankle joint, where we have a reduction in the presence of pain/discomfort, but without statistically significant difference (Table 3).

After the first examination, it was determined that the largest number of respondents had a WAI score in the range of 37-43, which corresponds to the categorization of good, followed by respondents with a WAI score in the range of 28-36 or moderate categorization, respondents with a WAI score in the range of 44-49 which corresponds to the categorization of excellent, and the smallest number of respondents who have a WAI score in the range of 7-27, which corresponds to the categorization of poor. After the second test, the comparison of WAI score categories shows that there is a statistically significant difference between the period before and after the introduction of the EIP (χ^2 = 15.231; p = 0.002). This difference is reflected in the decrease in the percentage of respondents with a WAI score in the poor category from 19.8% to 7.3%, the same share with a moderate score of 26.0%, and an increase in the percentage of respondents with a score in the good category from 39.5% to 41.2% and excellent from 14.7% to 25.4% (Table 4).

TABLE 2. Presence of pain/discomfort in the upper limbs region before and after the implemented ergonomic intervention program

Region	Yes	No	Significance
Right shoulder			
Before	75 (42.4%)	102 (57.6%)	χ^2=17.193; p=0.001
After	43 (24.3%)	134 (75.7%)	
Left shoulder			
Before	72 (40.7%)	105 (59.3%)	χ^2=16.934; p=0.001
After	41 (23.2%)	136 (76.8%)	
Right elbow			
Before	34 (19.2%)	143 (80.8%)	χ^2=9.652; p=0.022
After	24 (13.6%)	153 (86.4%)	
Left elbow			
Before	36 (20.3%)	141 (79.7%)	χ^2=9.497; p=0.023
After	20 (11.3%)	157 (88.7%)	
Right wrist/hand			
Before	69 (39.0%)	108 (61.0%)	χ^2=13.632; p=0.003
After	43 (24.3%)	134 (75.7%)	
Left wrist/hand			
Before	54 (30.5%)	123 (69.5%)	χ^2=8.889; p=0.031
After	33 (18.6%)	144 (81.4%)	

TABLE 3. Presence of pain/discomfort in the lower limbs region before and after the implemented ergonomic intervention program

Region	Yes	No	Significance
Right hip/thigh			
Before	44 (24.9%)	133 (75.1%)	χ^2=8.817; p=0.032
After	28 (15.8%)	149 (84.2%)	
Left hip/thigh			
Before	47 (26.6%)	130 (73.4%)	χ^2=12.924; p=0.005
After	23 (13.0%)	154 (87.0%)	
Right knee			
Before	66 (37.3%)	111 (62.7%)	χ^2=19.193; p=0.0001
After	33 (18.6%)	144 (81.4%)	
Left knee			
Before	67 (37.9%)	110 (62.1%)	χ^2=17.128; p=0.001
After	36 (20.3%)	141 (79.6%)	
Right ankle/foot			
Before	42 (23.7%)	135 (76.3%)	χ^2=6.393; p=0.094
After	25 (14.1%)	152 (85.9%)	
Left ankle/foot			
Before	43 (24.3%)	134 (75.7%)	χ^2=12.352; p=0.006
After	19 (10.7%)	158 (89.3%)	

The average value of the WAI index in the sample before the introduction of the EIP was 35.44 ± 8.59, with a median of 37 corresponding to the categorization "good," and the lowest index of work ability eight, and the highest 49. The average value of the index of work ability after implemented EIP was higher and amounted to 38.40 ± 7.30, which still corresponds to the categorization "good" and that it is necessary to continue working on improving work ability, with the lowest WAI of 12, and the highest of 49. Statistical analysis indicated a significant increase in the WAI index after the implementation of the EIP (t = 3.494; p = 0.001).

Comparison of the WAI score after the implementation of the EIP showed that subjects who performed exercises within the EIP had a higher average WAI score of 39.27 ± 7.38 compared to subjects who had an EIP and did not perform exercises with an average WAI score of 35.69 ± 6.37, which was confirmed by statistical analysis and indicated a significant difference in the WAI score (t = 4.103; p = 0.005) (Table 5).

By analyzing the WAI score categories according to the performance of the exercises, we noticed that a good and excellent WAI score after the implementation of the EIP was significantly more often obtained by subjects who had an EIP and exercised compared to those subjects who had an EIP and did not exercise, and a moderate a significantly higher number of respondents who had an EIP and did not exercise 46.5% compared to those respondents who had an EIP and did exercise 19.4%. Statistical analysis indicated a significant difference in WAI categories between respondents who exercised within the EIP compared to respondents who had an EIP and did not perform the offered exercise program (χ^2 = 15.613; p = 0.001) (Figure 1).

DISCUSSION

Health-care professionals are a very vulnerable category regarding the occurrence of musculoskeletal disorders at

TABLE 4. WAI categories before and after the implemented ergonomic intervention program

WAI category	Before	After	Significance
Poor (7-27)	35 (19.8%)	13 (7.3%)	χ^2=15.231; p=0.002
Moderate (28-36)	46 (26.0%)	46 (26.0%)	
Good (37-43)	70 (39.5%)	73 (41.2%)	
Excellent (44-49)	26 (14.7%)	45 (25.4%)	
Total	177 (100.0%)	177 (100.0%)	

WAI: Work capacity index

TABLE 5. Comparison of WAI scores according to exercise performance

Conducting exercises	$\bar{X}$	SD	SEM	Min.	Max.
Exercised	39.27	7.38	0.64	12	49
Did not exercise	35.69	6.37	0.97	18	49

t=4.103; p=0.005. WAI: Work capacity index

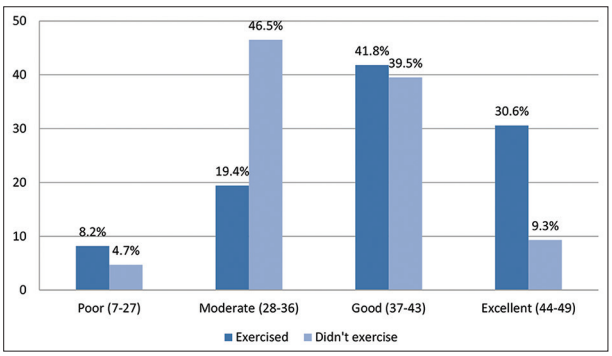

FIGURE 1. Work capacity index score categories according to exercise.

the workplace (6). Studies conducted in many countries around the world reveal that these disorders represent an important problem among health-care professionals (7).

The study conducted by Dong et al., which included employees of eight clinics from the Shandong province in China, found that in the past 3 months, 4.8% of respondents felt pain or discomfort in the neck region, pain or discomfort in the upper back region 1.1% of respondents, and 14.3% of respondents felt pain or discomfort in the region of the lower back (8).

Anderson and Oakman in a review study entitled "Musculoskeletal disorders in allied health professions," based on a review of the scientific literature, determined that the lower back is the most frequently affected part of the body among health-care professionals (9).

The results of the study carried out by Dong et al. in China are correlated with our results, with the fact that in their research there was a smaller number of respondents who felt pain or discomfort in the neck, upper, and lower back area compared to the results of our study, while the study conducted by Anderson and Oakman found that the lower back is the most frequently affected part of the body, which is not the case in our study where the most frequently affected part of the body among health-care professionals is the neck region.

A study conducted by Lorusso et al. involving radiologists employed in 13 hospitals from the Apulia region in southern Italy found that of the total number of respondents (n = 203), 21.2% of them reported pain/discomfort in the shoulder area in the past period (10). These results are correlated with our results, with the fact that the authors included only the radiology employees in the study, while our study processes data related to pain/discomfort in the shoulder area of all healthcare professionals.

Ayanniyi et al.'s study in which hospital staff from 12 clinics from Nigeria were involved found that out of the total number of respondents included in the study (n = 742), 12.8% of them answered affirmatively that they had pain/discomfort in the elbow area in the past period (11).

Mbada et al. with a study involving healthcare professionals employed at the University Clinical Center in Ile-Ife, Nigeria, whose aim was to investigate the prevalence of WRMSDs and factors that may be associated with these disorders in healthcare professionals, it was determined that of the total number of healthcare professionals involved in the study (n = 182), 18.0% of them affirmatively answered that they had pain/discomfort in the area of the wrists or hands in the past period (12).

The results of the study carried out in Nigeria are approximately equal to our results, with the fact that the authors of the study performed only one measurement, while our study processed the value before and after the implemented EIP.

A study conducted by Elsherbeny et al. in Egypt among healthcare professionals at a university children's hospital found that of the total number of subjects included in the study (n=311), 74.9% of them reported having pain in the hip area, which according to their study is the second most common musculoskeletal problem right after the pain in the elbow area (13).

The results of the research carried out in Egypt are correlated with our research regarding the occurrence of pain in the hip area among healthcare professionals with an evident difference that shows that the respondents included in the study in Egypt have a significantly greater problem with pain in the hip area than the respondents included in our study.

Mirmohammadi et al., in a study conducted in Iran in which healthcare professionals were involved, found that of the total number of respondents included in the study (n = 110), 24.5% stated that they had pain in the knee area in the last 12 months, which according to their study represents the most common musculoskeletal disorder (14), while a study conducted by Kumar Das and Mukhopadhyay, which included healthcare professionals employed in various healthcare institutions from Mumbai and Calcutta, India, found that pain/discomfort in the knee area in the past 12 months had is 15.23% of healthcare professionals (15).

The results of the study conducted in Iran and India are approximately equal to the results of our study, with the fact that our study dealt with the value before and after the implemented EIP.

A study conducted by Mansour Attar and colleagues in Saudi Arabia, which included nurses-medical technicians employed at the "King Abdul Aziz" University Hospital, found that of the total number of respondents (n = 200), 41.5% had pain in the area ankle joints or feet, which represents the second most common problem, right after pain in the lower part of the back (16).

The results of the study carried out in Saudi Arabia are correlated with the results obtained in our study, with the fact that the authors included only nurses – medical technicians and performed only one measurement, while our study included all healthcare professionals and analyzed the value before and after the implemented EIP.

The study conducted by Peralta et al. in Argentina included health-care professionals employed in primary healthcare at health centers. The authors examined the WAI and found that the largest number of respondents, 50% of them, have a WAI score in the range 37-43, which corresponds to the categorization of good, followed by respondents with a WAI score in the range of 44-49, which corresponds to the categorization of excellent, or 38% of them. respondents with a WAI score in the range of 28-36, which corresponds to the categorization of moderate, 12% of them, while none of the respondents had a WAI score in the range of 7-27, which corresponds to the categorization as poor (17).

The results of the study carried out in Argentina are correlated with our results, with the fact that the authors from Argentina determined that the largest number of respondents had a WAI score that corresponds to the categorization as good as in our study. This is followed by respondents with a WAI score that corresponds to the categorization of excellent, while in our study, respondents with a WAI score that corresponds to the categorization of moderate follow in frequency.

According to the study conducted by Mehrdada et al., healthcare professionals employed at the "Beharloo University Hospital" in Tehran were involved, it was determined that the average value of the WAI of the respondents was 40.3 ± 5.2, which corresponds to the "good" categorization, which means that work ability should be improved (18).

The results of the research carried out at the University Hospital in Tehran are correlated with the results obtained in our research, with the fact that the authors from Tehran performed one measurement of the average value of the WAI in the subjects, while our study included the measurement of the average value of the WAI in the subjects before and after implementing an EIP.

CONCLUSION

The highest incidence of WRMSDs among healthcare professionals was recorded in the neck area, followed by the upper back area, and the lower back area. In relation to the upper limbs, the highest frequency of disorders was in the shoulder area, while in relation to the lower limbs, the highest frequency of disorders was in the knee area.

The analysis of the WAI of health-care professionals determined that there is a statistically significant difference between the period before and after the introduction of the EIP. The difference is reflected by the decrease in the percentage of respondents with a WAI score in the poor category and an increase in the percentage of respondents with a score in the good and excellent category.

After the implementation of the EIP, there was a statistically significant decrease in the frequency of WRMSDs among health-care professionals in all body regions except the right foot, as well as a statistically significant increase in the average value of the WAI.

Based on the obtained results of our study, the positive influence of the EIP on reducing the frequency of musculoskeletal disorders caused by work and increasing the work ability of our subjects was proven. The fact that a large number of healthcare professionals accepted to participate in our study and that healthcare professionals are aware of the magnitude of the problem is also positive, which is one of the key factors in solving this problem. Furthermore, in solving this problem, it is very important to include a multidisciplinary team in which physiotherapists themselves will play an important role. As an important link, they should greatly contribute with their knowledge and work experience. This topic, regardless of the fact that it has been explored for many years, still represents an inexhaustible and very interesting basis for future research, by current and future researchers in the field of healthcare.

DECLARATION OF INTERESTS

Authors declare no conflict of interest.

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