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The relationship between individual, physical and psychosocial risk factors with musculoskeletal disorders and related disabilities in flight security personnel

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Purpose. The purpose of this study was to investigate the relationship between individual, physical and psychosocial risk factors with musculoskeletal disorders and related disability in flight security personnel. *Methods*. The study was conducted among 316 employees in Iran flight security. To study the prevalence of musculoskeletal disorders, lifestyle, occupational stress, mental workload and disability, the Cornell questionnaire, Walker lifestyle questionnaire, job content questionnaire, NASA task load index and pain disability questionnaire were used, respectively. Data were analyzed using independent-sample *t* test, one-way analysis of variance, χ^2 test and multiple logistic regression. *Results*. A total 68.35% of participants had musculoskeletal disorders in at least one of their body parts. There was a significant relationship between the parameters of increased age, higher work experience, high body mass index, gender and educational level and the prevalence of musculoskeletal disorders. Also, some components related to healthy lifestyle, occupational stress and mental workload had significant association with mentioned disorders ($p < 0.05$). *Conclusion*. The parameters of lifestyle, occupational stress and mental workload are among the most important risk factors for the prevalence of work-related musculoskeletal disorders and related disabilities in flight security personnel. Therefore, corrective measures through controlling individual, physical and psychosocial risk factors are necessary.

Keywords: musculoskeletal disorders; occupational stress; mental workload; lifestyle; flight security personnel

1. Introduction

Work-related musculoskeletal disorders (WRMSDs) are the most common occupational diseases and injuries, and the leading cause of disability, loss of time and economic losses [1–4]. WRMSDs may be caused by cumulative exposure to their contributing factors during a long-term process or suddenly caused by a severe trauma to a part of the musculoskeletal system. These injuries are often multifactorial phenomena [5]. Some of the symptoms include discomfort, pain, fatigue, dryness, swelling, restriction in range of motion, muscle cramps, numbness and tingling [6]. The risk factors for WRMSDs can be divided into four categories: work-related physical or biomechanical factors, work-related organizational or psychological factors, individual factors and social factors [3,7,8]. The main physical risk factors are lifting and moving heavy loads, applying force, contact pressure, repetitive movements, vibration, undesirable static postures and improper work organization [7]. In Iran, musculoskeletal disorders are the main source of disability and related costs. According to available statistics, nearly 48% of work-related illnesses are cumulative injuries caused by physical factors [9].

In workplaces, if individuals' physical and mental abilities do not match their job demands, they may experience various negative consequences, such as increased job dissatisfaction and absenteeism, occupational stress, reduced physical ability, fatigue and reduced job performance [10,11]. One of the most important negative consequences is an increase in the prevalence of WRMSDs [11]. One of the cognitive factors affecting occupational injuries and accidents is the incompatibility between the mental workload imposed on the individual and his or her abilities and limitations [12]. The workload has complex and multidimensional concepts; in simple terms, mental workload is the amount of effort that the mind performs during the task and is fundamentally related to one's mental abilities and how information is received and processed, and, ultimately, leads to decisions and actions [13]. In the workplace, mental workload is determined by the demands of the job, the conditions under which work is performed and the skills, behaviors and perceptions of individuals [14]. The needs of an occupation may include physical or mental actions, and the impact of these demands depends on the individual's ability to perform his or her job [15]. Mental workload makes it easier to influence physical and

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psychological risk factors in the development of musculoskeletal disorders [16]. Previous studies have shown that increased workload and occupational stress increase the risk of musculoskeletal disorders in individuals [17–19].

Another significant risk factor that can lead to the prevalence of musculoskeletal disorders and disability in the workplace is lifestyle. Lifestyle is a set of habits and activities that people do in their ordinary life [20]. The World Health Organization (WHO) defines lifestyles as distinct and definable patterns that result from the interaction between personal characteristics, the interaction of social relationships and environmental and socioeconomic situations [21]. Previous studies have shown that components of poor healthy lifestyles such as smoking, obesity, poor eating habits, sleep problems, stress and sedentary life are factors that contribute to the prevalence of chronic diseases such as musculoskeletal disorders, and lifestyle modification can be an effective step in reducing the prevalence of these disorders in the workplace [22,23]. In most countries, musculoskeletal disorders are considered one of the most common, most debilitating and most costly disorders, and impose significant health and economic damage on individuals and communities each year [24]. Approximately 33% of work absences in developed and developing countries are due to WRMSDs [25].

One of the most stressful jobs is working in a flight security team, which is responsible for protecting passengers and controlling all airlines to prevent any anti-security measures. Personnel in the flight protection team perform a variety of tasks, including inspecting people at flight gates, identifying and preventing any anti-security measures and ensuring complete flight security until passengers arrive at their destination. Long hours of flight, undesirable postures during people's inspections and sitting in a static position as well as high levels of psychological risk factors like high stress, high workload, etc., are other reasons for musculoskeletal problems in this group. Limited studies have also revealed that over 87% of airline staff reported musculoskeletal disorders [26,27]. Therefore, according to the mentioned facts, and considering the important role of risk factors such as workload, occupational stress and lifestyle ingredients as important and influential factors in the prevalence of musculoskeletal disorders in the workplace, the importance of examining the disabilities and limitations that are created in one's daily life as an important factor in the workforce and community health and, also, the absence of a similar study that considers the role of all of these risk factors as the underlying causes of WRMSDs among those working in the country's flight security, which is one of the most important occupations in society, the present study aimed to investigate the relationship between individual, physical and psychosocial risk factors and musculoskeletal disorders and related disability in flight security personnel.

2. Methods

2.1. Study design

This descriptive-analytical and cross-sectional study was carried out in 2019 among Iran flight security staff. The statistical population of the study consisted of all staff working in the field of flight security in Iran (4000 employees). The sample size was 357 employees, determined by applying the Cochran formula with an error level of 0.05. The sample size was selected from all flight security personnel using a simple random sampling method. After deleting confounded and incomplete questionnaires and considering the rate of response, 316 individuals were finally studied (response rate was 88.5%). Inclusion criteria included at least 1 year of work experience in the flight security team and exclusion criteria were defined as a history of systemic diseases of the musculoskeletal system such as a history of upper-limb, lower-limb and spine surgery, a history of spine or hip fractures, osteoporosis, pregnancy and lack of enough consent to participate in the study. Before conducting the study and completing the questionnaires, a training class was designed to justify to the commanders and all members of the flight security team the purpose of conducting research, to maximize their participation, and all information needed for completing the questionnaires was provided to the individuals. The ethics committee of the university approved the methodology of the study. Demographic data were extracted using a self-administrated questionnaire and the following questionnaires were applied to obtain the main variables.

2.1.1. Cornell musculoskeletal discomfort questionnaire

The Cornell musculoskeletal discomfort questionnaire (CMDQ) was used to determine the prevalence and severity of WRMSDs. The questionnaire is divided into three sections: frequency of discomfort; severity of discomfort; impact of discomfort on work ability. It has a body map and examines 12 body parts, totaling 20 areas of the body. The results of the three parts of the questionnaire are multiplied for each limb, with the final numerical result ranging from 0 to 90. The validity and reliability of this tool have been confirmed in previous studies (Cronbach's $\alpha = 0.986$) [28].

2.1.2. Walker's health-promoting lifestyle questionnaire

This questionnaire was first designed by Walker et al. [29] and consists of 52 questions that measure six dimensions of spiritual growth, health responsibility, interpersonal relationships, stress management, exercise and physical activity, and nutrition with eight or nine questions. Each question has four Likert-scale answer options, including 1 = *never*, 2 = *sometimes*, 3 = *most of the time* and 4 = *always*. The minimum score on this questionnaire is 52

and the maximum is 208. High scores indicating a better health-promoting lifestyle. A score of 52–104 is classified as poor lifestyle, a score of 105–157 is classified as an average lifestyle and a score of 158–208 is classified as good lifestyle. The validity and reliability of this tool have been confirmed in previous studies (Cronbach's $\alpha = 0.82$) [30].

2.1.3. *Job content questionnaire*

The dimensions of occupational stress were assessed by the translated Persian version of the job content questionnaire (JCQ). The ingredients of the questionnaire are three items to assess the dimension of decision-making or control, five items to assess the psychological demands of the job, eight items to assess the social support dimension, five items to assess the physical demands of the job and three items to assess the dimension of job insecurity. This instrument presents questions in a Likert-scale format, varying from 1 = *strongly disagree* to 4 = *strongly agree*. The criteria suggested in the job content questionnaire guidelines were used to form the model of demand-control houses. To achieve this model, two dimensions of demand and control were divided into two groups of up and down using the median as the cut-off point. Eventually, four houses were formed, including job with high strain (high job demands and low job controls), active job (high job demands and high job controls), job with low strain (low job demands and high job controls) and passive job (low job demands and low job controls) [31]. The validity and reliability of this questionnaire have been confirmed in previous studies (Cronbach's $\alpha = 0.85$) [31,32].

2.1.4. *NASA task load index questionnaire*

This questionnaire was used to assess mental workload. The NASA task load index (NASA-TLX) is a multidimensional approach that provides an overall score of workload based on a weighted average for six scales of intellectual and mental demand, physical demand, temporal demand, effort, overall performance and frustration level. The participant scores each of the six dimensions from 0 to 100 based on their working conditions. Using the hierarchical analytical method, the importance of each dimension relative to the other dimensions is examined. In this case, the person chooses the option that is most relevant to the activity between the two cases. Each selection is equal to a weighted score for that item. By multiplying the weight of each dimension of the workload (ranging from 0 to 1) by the scale score for each dimension (ranging from 0 to 100), the total workload of the individual is calculated numerically from 0 to 100. In fact, the overall score is expressed as a weighted workload. According to the questionnaire, if the overall workload score is less than 50 the risk level is low and if it is above 50 the risk level is high. The validity and reliability of this questionnaire have been confirmed in previous studies (Cronbach's $\alpha = 0.897$) [33,34]. The questions and definitions for each of the subscales of this questionnaire are presented in Table 1.

2.1.5. *Pain disability questionnaire*

The pain disability questionnaire (PDQ) is one of three common methods for determining the different dimensions of pain disorders. It consists of 15 questions and the answer to each question is in the Likert range from 0 to 10, so that for each question 0 means the best performance and 10 means the complete disability. Finally, the total score of the questionnaire is determined from 0 to 150. A range of 0–70 means moderate disability, 71–100 means severe disability and a score range of 101–150 means very severe disability. The validity and reliability of this tool have been confirmed in previous studies (Cronbach's $\alpha = 0.93$) [35].

2.2. *Data analysis*

After data collection, the Kolmogorov–Smirnov test was used to check the normality of the data distribution. The results of the Kolmogorov–Smirnov test revealed that the distribution of data was normal in all cases ($p > 0.05$). Descriptive statistics (such as mean, standard deviation and frequency) were presented and data analysis was performed using the independent-sample t test (differences in mean between two independent groups), one-way analysis of variance (ANOVA) (differences in mean between three or more independent groups), χ^2 test (association between categorical variables) and multiple logistic regression model at the significance level of 0.05 in SPSS version 25.0. In the multiple logistic regression model, by eliminating the effect of confounding variables, the most significant risk factors for the prevalence of musculoskeletal disorders are identified. For this purpose, based on the results of the independent-sample t test and χ^2 test, variables that were significantly associated with the prevalence of WRMSDs were entered into the multiple logistic regression model. Then, a backward elimination method was used to create the final regression model.

3. Results

The results of the present study showed that mean age, work experience, working hours per day and body mass index (BMI) among all participants were 34.04 ± 6.49 years, 10.84 ± 5.77 years, 11.08 ± 1.81 h and 26.71 ± 4.05, respectively. It was also found that the mean hours of sleeping time per person was 5.95 ± 1.62 h. Examination of BMI showed that 38.8, 47.5 and 13.7% of subjects were in normal, overweight and obesity class 1 levels, respectively. Eighty-one percent of the studied participants were male. The majority (83%) of the participants were married. Other demographic characteristics depending on the presence or absence of WRMSDs in the personnel are presented in Table 2.

Table 1. Definition of the NASA task load index questionnaire's six subscales [15].

Subscale	Endpoint	Definition
Mental demand	Low/high	How much mental activity is required?
Physical demand	Low/high	How much physical activity is required?
Temporal demand	Low/high	How much time pressure do you feel due to the pace at which the tasks or task elements occur?
Effort	Low/high	How hard do you have to work (mentally and physically) to accomplish your level of performance?
Overall performance	Low/high	How successful are you in performing the task? How satisfied are you with your performance?
Frustration level	Low/high	How irritated, stressed and annoyed versus content, relaxed and complacent do you feel during the task?

Table 2. Demographic characteristics of the respondents ($n = 316$).

Demographic variable (unit)		Value, *M* (*SD*) or percentage		
		With WRMSDs ($n = 216$)	Without WRMSDs ($n = 100$)	*p*
Age (years)		35.76 (7.61)	33.61 (4.96)	0.001**
Gender (%)	Male	78	83	0.034*
	Female	22	17	
Work experience (years)		12.73 (6.36)	9.26 (4.68)	0.001**
Working hour per day (h)		11.34 (1.83)	10.86 (1.77)	0.021*
Sleeping hour per day (h)		5.92 (1.64)	6 (1.6)	0.670
Height (cm)		175.02 (7.75)	176.72 (8.81)	0.453
Weight (kg)		83.31 (11.69)	81.51 (11.38)	0.177
BMI		27.15 (3.08)	26.34 (2.98)	0.018*
BMI level (%)	Normal (18.5–24.9)	29.7	39.8	0.020*
	Overweight (25–29.9)	50.8	44.3	
	Obesity class 1 (30–34.9)	19.5	15.9	
Marital status (%)	Single	19	21	0.301
	Married	81	79	
Education level (%)	Diploma	36.9	23.7	0.021*
	Associate degree	43.8	39.3	
	Bachelor	19.3	34.5	
	Master	0	2.5	

*Significant correlation at 5% significance level ($p < 0.05$).
**Significant correlation at 1% significance level ($p < 0.01$).
Note: BMI = body mass index; WRMSD = work-related musculoskeletal disorder.

There was a significant relationship between age, gender, work experience, working hours per day, BMI and educational level of the subjects and the prevalence of musculoskeletal disorders ($p < 0.05$).

3.1. *Prevalence of work-related musculoskeletal disorders*

Assessment of the prevalence of musculoskeletal disorders revealed that 31.65% of the personnel had no musculoskeletal disorders and 68.35% had musculoskeletal disorders in at least one of their body parts. The highest prevalence of musculoskeletal disorders was observed in the neck, left knee, right knee and waist with values of 67.4, 62.3, 60.8 and 59.2%, respectively. Also, the lowest prevalence of disorders was observed in the left and right arms with values of 31 and 30.4%, respectively (Table 3).

3.2. *Lifestyle score values*

The findings of the lifestyle survey showed that the mean score for lifestyle among all of the participants was 132.67 ± 20.44. It was found that 6.3% of the participants had a poor lifestyle, 75% had a moderate lifestyle and 18.7% had a good and favorable lifestyle. The results showed that the average score for lifestyle among personnel with disorders and without disorders was 130.28 ± 18.31 and 134.66 ± 21.29, respectively. It was also found that the dimensions of health responsibility, stress management, exercise and nutrition were higher in participants without WRMSDs. There was also found a significant relationship between the dimensions of health responsibility, stress management, exercise, nutrition and overall lifestyle score and the prevalence of WRMSDs ($p < 0.05$) (Table 4).

Table 3. Prevalence and severity of WRMSDs in different body parts of the study subjects.

Body part		Prevalence of WRMSDs (%)					Severity of disorders (%)		
		Never	1–2 times a week	3–4 times a week	Once a day	Several times a day	Low	Moderate	High
Neck		32.6	35.4	14.6	10.4	7	60.4	28.5	11.1
Shoulder	Right	48.7	24.4	17.1	8.2	1.6	67.4	26.6	6
	Left	51.3	23.4	13.9	9.8	1.6	68	25	7
Upper back		42.7	33.5	14.9	4.7	4.2	71.8	22.8	5.4
Upper arm	Right	69.6	19	5.1	6.3	0	80.4	15.5	4.1
	Left	69	18	6.3	5.4	1.3	80.1	18	1.9
Lower back (waist)		40.8	28.5	15.5	7.6	7.6	69.3	20.9	9.8
Forearm	Right	62.7	19.9	11.4	6	0	81.3	18.7	0
	Left	61.7	24.4	7.3	6.6	0	78.5	19.3	2.2
Wrist	Right	56.6	20.3	15.2	6	1.9	76.3	19.6	4.1
	Left	58.9	25	10.1	6	0	75.6	20.6	3.8
Hip		57.9	27.8	7.7	4.7	1.9	81.3	15.2	3.5
Thigh	Right	65.5	22.8	4.7	5.7	1.3	85.5	8.2	6.3
	Left	64.9	23.4	5.1	5.4	1.2	79.7	12	8.3
Knee	Right	39.2	38.6	9.8	7.6	4.8	54.7	35.8	9.5
	Left	37.7	35.4	12.3	9.9	4.7	56.3	31	12.7
Leg	Right	55.4	20.9	7.3	8.5	7.9	71.5	20.3	8.2
	Left	55.4	2.8	8.5	7	6.3	69.9	19.6	10.5
Foot	Right	47.2	25.3	10.8	8.5	8.2	58.2	30.4	11.4
	Left	45.6	24.9	11.8	7.9	9.8	57.9	28.8	13.3

Note: WRMSD = work-related musculoskeletal disorder.

Table 4. Mean scores for the dimensions of lifestyle among the studied personnel ($n = 316$).

Dimension	Without WRMSDs ($n = 100$), M (SD)	With WRMSDs ($n = 216$), M (SD)	All personnel ($n = 316$), M (SD)	p
Spiritual growth	30.42 (4.77)	30.45 (5.32)	30.39 (5.14)	0.903
Health responsibility	33.88 (6.80)	31.38 (5.44)	32.90 (6.49)	0.001**
Interpersonal relationships	20.60 (3.83)	20.68 (3.90)	20.65 (3.87)	0.866
Stress management	13.44 (3.37)	12.41 (3.48)	13.10 (3.43)	0.013*
Physical activity	18.14 (5.47)	16.85 (4.83)	17.95 (5.04)	0.005**
Nutrition	18.54 (4.34)	17.30 (3.38)	18.13 (4.09)	0.011*
Lifestyle overall score	134.66 (21.29)	130.28 (18.31)	132.67 (20.44)	0.04*

*Significant correlation at 5% significance level ($p < 0.05$).
**Significant correlation at 1% significance level ($p < 0.01$).
Note: WRMSD = work-related musculoskeletal disorder.

3.3. *Occupational stress score values*

The score for occupational stress dimensions are presented in Table 5. It should be noted that the higher mean score for the dimensions of decision-making and social support indicates less stress. The higher mean score for the dimensions of job psychological demands, job physical demands and job insecurity indicates high stress. Based on comparing the mean score obtained for each dimension with the obtainable values that can be achieved for any dimension, it was found that the mean score for the dimension of decision-making was low and for the dimension of social support was relatively high, which indicates high and low levels of stress, respectively. The mean scores for the dimensions of job psychological demands and job insecurity were low, which indicates fewer stress levels. It was also found that the mean score for the dimension of job physical demands among participants was high, which indicates high stress levels in this area. It was found that the mean score for job physical demands in personnel with WRMSDs was significantly higher than for those without any WRMSDs and there was a significant relationship between these two factors ($p < 0.05$) (Table 5).

3.4. *Mental workload score values*

The study of the mental workload values based on the NASA-TLX showed that the mean score for the mentioned index was 66.87 ± 11.42 and was in the high workload range. It was found that the highest and the lowest scores were observed in effort and frustration level with values of 64.94 ± 16.81 and 40.06 ± 16.75, respectively. A survey of mental workload score in two groups of personnel with WRMSDs and without any WRMSDs showed that the

Table 5. Mean scores for the dimensions of occupational stress among the studied personnel ($n = 316$).

Dimensions	Without WRMSDs ($n = 100$), M (SD)	With WRMSDs ($n = 216$), M (SD)	All personnel ($n = 316$), M (SD)	p
Decision-making	36.81 (4.6)	35.73 (5.26)	35.41 (4.82)	0.156
Job psychological demands	18.27 (3.43)	18.82 (2.24)	18.50 (2.68)	0.830
Social support	28.31 (4.16)	28.64 (5.86)	28.78 (4.78)	0.129
Job physical demands	13.70 (2.20)	16.83 (2.71)	15.29 (2.37)	0.001**
Job insecurity	5.13 (2.17)	5.41 (2.26)	5.23 (2.23)	0.846

**Significant correlation at 1% significance level ($p < 0.01$).
Note: WRMSD = work-related musculoskeletal disorder.

Table 6. Mean scores for the six dimensions of mental workload based on the NASA task load index among the studied personnel ($n = 316$).

	Without WRMSDs ($n = 100$)		With WRMSDs ($n = 216$)		All personnel ($n = 316$)		
Dimensions	M	SD	M	SD	M	SD	p
Mental demand	56.11	19.76	57.93	18.79	58.34	19.1	0.437
Physical demand	61.42	20.42	64.55	20.67	63.14	19.51	0.003**
Temporal demand	57.18	19.36	65.14	20.89	62.77	19.29	0.001**
Effort	61.50	15.33	65.92	17.16	64.94	16.81	0.030*
Overall performance	55.14	18.54	53.66	21.71	48.38	20.96	0.567
Frustration level	38.93	16.62	40.61	17.86	40.06	16.75	0.601
Mental workload overall score	61.72	10.54	68.34	11.89	66.87	11.42	0.008**

*Significant correlation at 5% significance level ($p < 0.05$).
**Significant correlation at 1% significance level ($p < 0.01$).
Note: WRMSD = work-related musculoskeletal disorder.

mean score for mental workload in these two groups was 68.34 ± 11.89 and 61.72 ± 10.54, respectively, and there was a significant relationship between these two parameters ($p < 0.05$). The study of the six dimensions of mental workload indicated that the mean scores for the dimensions of mental demand, physical demand, temporal demand, effort and frustration level in individuals with musculoskeletal disorders were higher. It was also found that there was a significant relationship between the scores for physical demand, temporal demand and effort dimensions and WRMSDs ($p < 0.05$) (Table 6).

3.5. *Pain disability score values*

The values of pain disability due to musculoskeletal disorders among all of the personnel demonstrated that the average score for the PDQ was 29.259 ± 25.415. Moreover 86.9, 12.2 and 0.9% of the subjects were at mild/moderate, severe and very severe disability levels, respectively. The mean score for disability in the two groups with WRMSDs and without WRMSDs were 37.70 ± 28.98 and 16.93 ± 13.26, respectively, and there was a significant relationship between WRMSDs and the amount of relevant disability ($p < 0.05$).

3.6. *Multiple logistic regression model*

Table 7 presents the most important risk factors for the prevalence of musculoskeletal disorders based on the multiple logistic regression model. There was a significant inverse relationship between the dimensions of health responsibility, stress management, physical activity and nutrition and the prevalence of WRMSDs. In addition, there was a significant and direct relationship between age, work experience, BMI, job physical demands, physical demand, temporal demand and effort and the prevalence of WRMSDs. Moreover, the percentages of personnel with WRMSDs based on the interaction/relationship between the most important studied risk factors are presented in Table 8.

4. Discussion

The present study on the effect of demographic risk factors on the prevalence of musculoskeletal disorders revealed that there was a significant relationship between age, gender, work experience, working hours per day, BMI and education level of the personnel and the prevalence of musculoskeletal disorders (Table 2). Previous studies have also shown that gender, increase of age, higher work experience and high BMI are among important risk factors

Table 7. Risk factors affecting the prevalence of WRMSDs using the modified multiple logistic regression model.

Variable	Index		
	OR [95% CI]	Regression coefficient β (*SE*)	*p*
Age	1.07 [0.98–2.11]	0.070 (0.036)	0.001**
Work experience	1.16 [1.08–2.27]	0.15 (0.032)	0.001**
Body mass index	1.11 [1.01–1.24]	0.108 (0.05)	0.002**
Health responsibility†	0.84 [0.68–0.96]	–0.17 (0.05)	0.001**
Stress management†	0.73 [0.44–0.86]	–0.31 (0.07)	0.003**
Physical activity†	0.88 [0.70–0.97]	–0.13 (0.05)	0.005**
Nutrition†	0.90 [0.73–0.98]	–0.11 (0.04)	0.011*
Job physical demands††	1.23 [1.08–1.34]	0.21 (0.06)	0.001**
Physical demand†††	1.39 [1.21–1.47]	0.33 (0.07)	0.004**
Temporal demand†††	1.07 [1.01–1.19]	0.07 (0.038)	0.001**
Effort†††	1.16 [1.12–1.27]	0.15 (0.05)	0.03*

†Lifestyle dimensions.
††Occupational stress dimension.
†††Mental workload dimensions.
*Significant correlation at 5% significance level ($p < 0.05$).
**Significant correlation at 1% significance level ($p < 0.01$).
Note: CI = confidence interval; OR = odds ratio; WRMSD = work-related musculoskeletal disorder.

Table 8. Percentage of personnel with WRMSDs based on the interaction/relationship between the most important studied risk factors.

Variables		Lifestyle				Job physical demands			Mental workload		
		Poor	Average	Good	*p*	Low	High	*p*	Low	High	*p*
Age (years)	22–28	34.9	33.5	31.6	0.12	38.2	61.8	0.003**	40.7	59.3	0.03*
	29–38	42.3	32.4	25.3	0.03*	34.1	65.9	0.001**	49	51	0.11
	>39	48.6	30.3	21.1	0.001**	36.3	63.7	0.003**	34.6	65.4	0.008**
Gender	Male	43.7	29.4	26.9	0.03*	31.6	68.4	0.04*	41.3	58.7	0.02*
	Female	50.6	27.4	22	0.002**	48.1	51.9	0.11	30.7	69.3	0.001**
Work experience (year)	1–5	42.9	33.2	23.9	0.07	35.3	64.7	0.003**	25.3	74.7	0.001**
	6–10	48.3	31.8	19.9	0.03*	32.6	67.4	0.001**	36.1	63.9	0.08
	>11	51.9	30.5	17.6	0.001**	33.5	66.5	0.04*	49.7	50.3	0.11
BMI level	Normal	37.8	33.9	28.3	0.03*	37.3	62.7	0.03*	50.9	49.1	0.16
	Overweight	43.6	32.3	24.1	0.003**	49.5	50.5	0.12	49	51	0.12
	Obesity class 1	46.2	35.9	17.9	0.001**	38.9	61.1	0.02*	50.3	49.7	0.23
Education level	Diploma	34.7	36.7	28.6	0.160	39.3	60.7	0.02*	42.3	57.7	0.03*
	Associate degree	48.5	30.4	21.1	0.08	42.8	57.2	0.03*	45.1	54.9	0.04*
	Bachelor and higher	51.7	32.3	16	0.02*	49.6	50.4	0.18	48.8	51.2	0.13

*Significant correlation at 5% significance level ($p < 0.05$).
**Significant correlation at 1% significance level ($p < 0.01$).
Note: BMI = body mass index; WRMSD = work-related musculoskeletal disorder.

for the prevalence of WRMSDs [22,36]. Concerning the relationship between education level and the prevalence of WRMSDs, as people with higher education level are employed in office jobs, they are less exposed to adverse physical conditions and the prevalence of WRMSDs in these personnel is lower, which is in line with the study by Hassanzadeh et al. [37]. We found that a high percentage of the participants had musculoskeletal disorders in at least one of their body parts. This indicates a high prevalence rate of musculoskeletal disorders among those working in flight security. The highest prevalence of WRMSDs was observed in the neck, left knee, right knee and waist, respectively. Also, the lowest prevalence of WRMSDs was observed in the left and right arms, respectively (Table 3). Limited studies of musculoskeletal disorders in airline staff have also indicated that over 87% of airline staff have reported musculoskeletal disorders [26,27].

The findings for the lifestyle survey demonstrated that the dimensions of health responsibility, stress management, exercise and nutrition were higher in participants without musculoskeletal disorders (Table 4). It seems that personnel without WRMSDs are more sensitive to their

health, try to control their stress, perform regular physical activity and exercise, and have a better nutritional status compared to staff with WRMSDs. They are consuming proper, diverse and essential nutrients for the body in their daily diet. Ultimately, lifestyle was found to be an important factor in the incidence and prevalence of musculoskeletal disorders, and in the present study, individuals without any WRMSDs had a better lifestyle, which is consistent with the results of previous studies [7,22].

In the study of the dimensions of occupational stress, it was found that the mean score for the decision-making (control) dimension was low among the subjects, which leads to an increase in the level of occupational stress [31]. The mean score for the social support dimension was relatively high, indicating that personnel received good support during work shifts from colleagues and supervisors, which leads to a decrease in occupational stress. The average scores for the dimensions of job psychological demands and job insecurity were low, which indicates fewer stress levels. The mean score for the dimension of job physical demands among participants was high, which indicates high stress levels in this area. It was found that the mean score for job physical demands in personnel with musculoskeletal disorders was significantly higher than those without any disorders and there was a significant relationship between these two factors (Table 5). The high physical demands can lead to a variety of physical injuries, such as musculoskeletal disorders. This indicates that high physical demands and poor physical condition during working time are important risk factors for the prevalence of WRMSDs in flight security staff. Barzideh et al. [38] showed in their study among nurses that, among the various components of occupational stress, there was only a significant relationship between physical demands and the prevalence of musculoskeletal disorders, which is consistent with the results of the present study. Mehta and Parijat [39] also found that decreasing the decision-making (control) dimension and increasing the dimension of physical demands of work eventually led to an increase in the prevalence of WRMSDs. The results also showed that the dimension of decision-making was higher in personnel without WRMSDs and the dimensions of job psychological demands and job insecurity were higher in staff with WRMSDs, but there was no statistically significant relationship between these dimensions and the prevalence of musculoskeletal disorders, which is in line with the results of previous studies [38,40]. All of the aforementioned indicates that the values of occupational stress dimensions are higher in personnel with WRMSDs compared to individuals without any disorders and that high occupational stress provided the basis for WRMSDs in the flight security staff.

The study of mental workload values based on the NASA-TLX revealed that the mean score for the mentioned index was 66.87 ± 11.42, which was in the high workload range. Reasons for the high workload in the present study include the need for high intellectual activity, continuous physical movement in unfavorable ergonomic situations, the need to perform tasks in a short and defined timeframe as well as the effort to maintain optimal performance due to the high sensitivity and importance of flight security tasks. The survey of mental workload scores in two groups of personnel with and without WRMSDs showed that personnel with musculoskeletal disorders have a higher mental workload compared to those without any disorders. Thus, it was determined that mental workload is one of the important parameters in the prevalence of WRMSDs in flight security staff, which is in agreement with the results of Zare et al.'s study [41]. The study of the six dimensions of mental workload showed that the mean scores for the dimensions of mental demand, physical demand, temporal demand, effort and frustration level in individuals with musculoskeletal disorders were higher. It was also found that there was a significant relationship between the scores for physical demand, temporal demand and effort dimensions and musculoskeletal disorders (Table 6), which is in line with the results of Hoboubi et al.'s study [11]. It was found that the study subjects needed more physical, mental and overall effort to do their work and time was more important in their jobs, and they had to perform their tasks in a short and definite time range. A study by Lee et al. [27] also indicated that risk factors such as high workload, temporal demand and high occupational stress due to the sensitivity of airline staff duties were among the most significant causes of the prevalence of WRMSDs.

The study of pain disability due to WRMSDs among all of the personnel showed that 86.9, 12.2 and 0.9% of the subjects were at mild/moderate, severe and very severe disability levels, respectively. There was a significant relationship between musculoskeletal disorders and the amount of disability in daily work resulting from the mentioned disorders. It is clear that the inability to perform the daily tasks and the negative effects resulting from this disability are higher in personnel with musculoskeletal disorders, and the prevalence of WRMSDs can affect individuals, families and, ultimately, society.

Finally, the results of the multiple logistic regression model showed that the parameters of age, work experience, BMI, dimensions of health responsibility, stress management, exercise and nutrition of lifestyle, physical demands of occupational stress and dimensions of physical demand, temporal demand and effort are among the most important risk factors for predicting the prevalence of WRMSDs in flight security personnel. There was an inverse relationship between the dimensions of health responsibility, stress management, exercise and nutrition and the prevalence of musculoskeletal disorders, and a significant and direct relationship was found between the other mentioned parameters and the prevalence of WRMSDs (Table 7).

The results of investigating the prevalence of WRM SDs based on the interaction/relationship between the most important studied risk factors indicated that the impact of lifestyle on the prevalence of WRMSDs among young personnel (22–28 years) was low and has the most significant impact at the age of 29 years and higher. It was also found that mental workload had no effect on the prevalence of WRMSDs in the age range of 29–38 years and exerted the greatest effect on personnel aged between 22 and 28 and over 39 years. Work experience causes a substantial effect on the impact of mental workload on the prevalence of WRMSDs. It was found that for employees with more than 11 years of work experience, mental workload did not affect the prevalence of WRMSDs (due to sufficient work experience). Other findings concerning the interaction between the most important studied risk factors are presented in Table 8.

Due to the high sensitivity of the tasks of flight security staff in controlling the security of the airlines and also protecting national security, the high prevalence of WRMSDs and, consequently, the disabilities created in the daily life of people working in the flight security team can lead to irreparable damage. One of the strengths of the present study is investigating the role of several individuals, physical and psychosocial risk factors in the prevalence of musculoskeletal disorders and its related disabilities in flight security staff for the first time in Iran and the world. Given the importance of various occupations for flight security staff, the results of the present study can provide novel insights into the prevalence of WRMSDs among these personnel and the consequences and adverse effects of these disorders on individuals and society. Therefore, considering the high sensitivity of the duties of flight security staff and the need to pay attention to their physical and mental health, taking control measures to reduce the prevalence of WRMSDs in flight security personnel through controlling the individual, physical and psychosocial risk factors is absolutely essential. One of the limitations of the present study was the impossibility of taking interventional measures due to time constraints. Therefore, to determine the exact role of each of the mentioned risk factors in the prevalence of WRMSDs, it is recommended that researchers conduct interventional studies in the future.

5. Conclusion

The findings of the present study revealed that the prevalence of musculoskeletal disorders and disabilities were high in the flight security team and the parameters of lifestyle, occupational stress and mental workload are among the leading risk factors for the prevalence of the WRMSDs and related disabilities. Therefore, taking corrective measures through controlling individual, physical and psychosocial risk factors such as continuous monitoring of the musculoskeletal system status of personnel to identify and implement suitable rehabilitation programs, redesigning workstations according to ergonomic principles, performing regular exercise to reduce BMI and maintain health, providing a rest schedule during working time, performing training programs and psychology workshops to manage stress and reduce workload, and providing a proper nutrition plan for personnel are necessary to reduce the prevalence of musculoskeletal disorders.

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