



Psychosomatic Causes of the Musculoskeletal System Diseases

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ABSTRACT

Aims The purpose of the study was to establish the relationship between psychological factors and impaired functioning of the musculoskeletal system.

Instrument & Methods To achieve the purpose of the study, numerous methods were used, including theoretical (analysis, synthesis, generalisation) and practical (Depression, Anxiety, and Stress Scales; Nordic Musculoskeletal Questionnaire; Copenhagen Psychosocial Questionnaire. Statistical significance between the studied indicators was established using Cronbach's Alpha coefficient.

Findings The results of the study established that employees who were in the range of average indicators according to the stress detection method had a higher risk of musculoskeletal disorders. These rates were high even considering some variables, such as smoking, age, and body mass index scores.

Conclusion Intense stress leads to disorders in the musculoskeletal system. In particular, such emotions as anger, frustration, annoyance, confusion, tension, hatred, anxiety, and nervousness cause stress. Not only the experience and frequency of such feelings but also the repetition of actions and movements cause injuries or disorders of the musculoskeletal system.

Keywords Disease; Musculoskeletal System; Psychosomatics; Personality; Mental Disorders; Life Stress

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Introduction

Disorders of the musculoskeletal system are defined as “muscular”, that is, pain, injuries that occur after damage to the muscular and nervous systems, provoke diseases of other systems and organs, reduced mobility, deterioration of the general condition of the human body, and negatively affect daily activities. These disorders can affect a person's abilities, performance, efficiency, well-being, productivity, and quality of work [1]. One of the psychological causes of musculoskeletal disorders is stress in a person's life in general and work in particular. It can worsen and eventually become chronic without amenable treatment. Chronic occupational stress is also associated with the development of burnout syndrome (emotional disorders, and mental and physical fatigue caused by excessive and prolonged stress) [2, 3].

Persistent pain, impaired mobility and function, and decreased quality of life and mental well-being are the most common experiences associated with musculoskeletal diseases, of which there are already more than 150 types [4, 5]. The relevance of the subject is conditioned upon the fact that according to the World Health Organization, musculoskeletal disorders are one of the most common causes of job loss and retirement. In addition, diseases of the skeletal apparatus, due to their carbonization, often lead to disability, which in turn causes social detachment, mental health disorders, and the occurrence of depression and anxiety symptoms. Diseases of the musculoskeletal system are more multi-morbid, that is, a person might have a history of several diseases associated with this system [6].

According to the National Institute of Occupational Safety and Health, musculoskeletal disorders are lesions of the human musculoskeletal system, especially bones, spinal discs, tendons, joints, ligaments, cartilage, nerves, and blood vessels [7]. Such injuries can occur due to repetitive movements, forces, and vibrations of human bodies while performing certain work. Work-related musculoskeletal symptoms can occur in the workplace when there is a discrepancy between the physical capabilities of the human body and the physical requirements of the task [8]. Disorders of the musculoskeletal system can be associated with work activity and working conditions. Most musculoskeletal diseases affect the functioning of the cognitive, emotional, and behavioral spheres of an individual [1]. Defining stress as the main factor of physical health disorders, it is worth noting that the link between stress and goal achievement is indisputable. Mental overexertion, failures, uncertainty, and a sense of purposelessness of existence are among the most harmless stressors. They are often the cause of various kinds of pain, ulcers, musculoskeletal problems, heart attacks, hypertension, mental disorders, suicides, or simply a hopelessly unhappy life [9]. At the end of the last

century, stress was recognized as a global problem of human survival. It has been called the “silent killer”, which can lead to heart disease, high blood pressure, chest pain, and arrhythmias. Therefore, issues of prevention and stress management began to be considered at the international level [10].

The study aimed to establish the relationship between psychological factors and impaired functioning of the musculoskeletal system.

Instrument & Methods

Both theoretical and practical application methods were used in the study. Theoretical research methods include analysis, synthesis, generalization, comparison, and classification. Analysis and synthesis are two interrelated logical methods of research, which are the processes of the mental or actual division of a whole into component parts and the integration of parts into a whole. The value of analysis is that the division of a complex phenomenon into simpler elements allows the separation of the essential from the minor and reduces the complex to the simple. The method of synthesis allows for composing the parts and understanding the phenomenon under study in general. Comparison is characterized by comparing an object or phenomenon to establish similarities or differences between them and to find common factors. The comparative method is always an important prerequisite for generalization, which highlights the characteristics of objects and allows the grouping of objects into types, groups, and other features (classification). The empirical study involved 430 firefighters, including 380 men (88.4% of the total number of participants) and 50 women (11.6%). The age of participants ranged from 21 to 60 years.

Psychosocial working conditions, health, and well-being were assessed using the Copenhagen Psychosocial Questionnaire (COPSOQ). This questionnaire uses 19 dimensions to determine the level of psychosocial stressors at work. Different dimensions are further divided into subcategories. Four different elements are used to assess “demand”, 5 points to assess “impact and development”, 8 scales, 1 point to measure “interpersonal support and relationships”, and 1 scale is used to assess “job insecurity”. In addition, 6 outcome variables were evaluated for job satisfaction, intention to leave, overall health, burnout (scale: Personal Burnout), cognitive stress, and life satisfaction. Overall, the standard version of COPSOQ consists of 87 points on a 5-point Likert scale. Basically, COPSOQ functions show values ranging from a minimum of 0 (meaning minimum or lowest possible value) to a maximum of 100 (meaning most likely value) [2]. Depression, anxiety, and stress (DASS) in firefighters were also assessed using the DASS scale. For the survey, a scaled variant (DASS-21) consisting of 21 elements was used, and

all questions were evaluated on the Likert scale [11]. A 4-point (range 0–3) severity scale measures the degree of experience of each condition in the last week, with 0 meaning “does not apply to me at all” and 3 – “applied to me strongly or most of that time”. The DASS-21 scale is further divided into 3 subscales, namely DASS using 7 elements for each subcategory. The Nordic Musculoskeletal Questionnaire (NMQ) was used to assess musculoskeletal problems. It consists of structured multiple-choice questions and answers in the form of a dichotomous “yes/no” answer. The questionnaire consists of 2 parts: a general questionnaire and a more detailed questionnaire for individual body parts. The questionnaire was designed to answer the question: “Do musculoskeletal problems occur in a particular population, and if so, in which part of the body are they localized?” Particular questions are then focused on each anatomical area. According to statistics from the World Health Organisation, musculoskeletal disorders are one of the most common causes of disability [12]. Upper limb pain is common; shoulder pain symptoms are present in approximately 18.6–31.0% (median 24.8%) of adults. The prevalence of knee pain in adults is 13.0–28.0% (median 20.5%). The prevalence of ankle and toe pain were 28.0, and 15.0, respectively [13].

All procedures performed in studies involving human participants were under the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The obtained data were imported into the statistical package SPSS 20 (Statistical Package for Social Sciences), which was used for statistical analysis. Differences in mean continuous and categorical variables were estimated using the t-criterion and χ^2 test, respectively. Simple and adjusted logistic regression models with many variables were used to assess the potential association between work-related stress and musculoskeletal symptoms.

Findings

Among participants 17% were aged 21-30 years, 39.5% were aged 31-40 years, 26.5% were aged 41-50 years, and 16.3% were aged 51-60 years. The majority of the study participants (77%) were firefighters, the rest of them were sergeants and senior officers (22.9%).

After analyzing the results obtained regarding the influence of stressful factors on the occurrence of problems with the musculoskeletal system, the following indicators were identified. Estimates of internal consistency and reliability of the scales used were quite high, as determined by Cronbach's Alpha coefficient, which was 0.91 for the DASS, and 0.90 for the Copenhagen Psychosocial Questionnaire (COPSOQ). The ratio between the results of these

two methods aimed at studying stress levels (COPSOQ and DASS methods) was 0.49 ($p < 0.001$). Using the DASS, it was established that 83.3%, 5.5%, 7.7%, 3.1%, and 0.5% of the samples were divided into the following categories: normal, mild, moderate, severe, and extremely severe stress, respectively (Table 1).

Table 1) Quantitative indicators of study participants on the DASS

Level	Number of participants
Normal	358
Mild	24
Average	33
Severe	13
Extremely heavy	2

Of particular interest were the correlation indicators between the stress subscale and the depression subscale according to the DASS method, which was 0.85 and statistically significant ($p < 0.001$). Overall, 40% of firefighters reported musculoskeletal problems that were identified using the Nordic Musculoskeletal Questionnaire (NMQ). The most common symptoms indicated by the results of the questionnaire are a pain in the back (18.5%), upper limbs (10.3%), upper back (9.4%), and ankles (5.5%). An interesting element of the study was that indicators on scales regarding stress levels and possible musculoskeletal symptoms were supplemented with several other variables. They included information about the age of participants, unhealthy habits (smoking), exercise, and body mass index (BMI). The data is presented in Table 2.

Table 2) Data of variables entered in the study

Variable	Number	Percent	
Smokers	Non	160	37.2
	Former	82	19.1
	Social	46	10.7
	Regular	142	33.0
BMI	<25	168	39.1
	25-30	204	47.4
	30<	53	12.3
Physical activity (times per week)	0	72	16.7
	1-2	160	37.2
	3-4	130	30.2
	5-6	37	8.6
	Daily	28	6.5

Firefighters who fell within the range of average work-related stress levels (COPSOQ scale) had an approximately 50% higher risk of musculoskeletal disorders, even after adjusting for age, smoking, and BMI scores. In addition, a link was found between stress caused by working conditions and reported musculoskeletal symptoms. Firefighters with above-average stress scores reported a larger list of musculoskeletal symptoms compared to firefighters whose results were below average. In quantitative terms, the indicators above the average exceeded the indicators below the average by 2-3 times. Regarding such a variable as exercise, it is worth noting that there are statistically significant

indicators between physical activity and registered symptoms of the musculoskeletal system. Firefighters who had physical activity had a 2-4-fold lower risk of musculoskeletal disorders. In addition, compared to firefighters who lead a sedentary lifestyle, firefighters who reported physical activity 1-2 days a week, 3-4 days a week, and more than 5 days a week had an approximately 2.5-fold, 2-fold, and 2.7-fold lower risk of reporting musculoskeletal symptoms, respectively. That was, as physical activity increased, the reported musculoskeletal symptoms decreased.

The study identified that approximately 1 out of 10 firefighters reported considerable work-related stress. This conclusion is based on two different international standardized scales. In addition, it was established that a high percentage of firefighters (40%) reported problems with the musculoskeletal system, among which the most common were: back pain, shoulder pain, and knee problems. Finally, a statistically significant association was established between occupational stress and the identified symptoms of the musculoskeletal system (even if such additional variables as bad habits were introduced). Notably, participants who scored above the average for the COPSQ stress subscale had an approximately 50% higher risk of developing musculoskeletal symptoms compared to those participants whose stress scores were in the low-level range.

Discussion

Psychosomatic symptoms are associated with mental problems that are reflected in the body. As a result of exposure, various organs and systems can be affected, and the musculoskeletal system is no exception.

The results of the study are supported by other scientific reports that link stress at work and problems with the musculoskeletal system. It is important to note that an earlier study (involving South Korean firefighters) also shed a light on a direct link between stress factors and diseases of the musculoskeletal system^[14]. The difference can only be traced to the affected organs. That is, in a study involving flight attendants, disorders occur in the lower back, in contrast to firefighters, who have more damage to the upper limbs^[2].

The summarization of the above notes that pain, especially chronic pain, creates a considerable burden for people and their families. It negatively affects the overall perception of health, considerably inhibits daily activities, is associated with depressive symptoms, and significantly and negatively affects relationships and interactions with others. The World Health Organisation's "Global Burden of Disease" uses the term "disability" to assess potential diseases not related to mortality^[15]. Disability-adjusted life years is a social indicator of the incidence or burden of disability among the

population. It is calculated by combining indicators of life expectancy and adjusted quality of life during severe illness or disability for the population. They define disability as any short- or long-term loss of health. Disability-adjusted life years (DALY) is a social indicator of the incidence or burden of disability among the population.

DALY and years lived with disability (YLD) are required to measure and compare the limitations of a wide range of pain-related disorders^[16]. DALY is calculated as the sum of two components:

$$\text{DALY} = \text{YLL} + \text{YLD} \quad (1)$$

Where YLL is the number of years of life lost due to premature death and YLD is the number of years lost due to disability.

Pain-related disorders characterized or defined by pain (lumbar pain, neck pain, other musculoskeletal disorders, migraines, and falls) account for 5 of the 10 largest conditions responsible for YLD in the world^[17]. Acute lumbar pain has caused 83 million DALY, and, according to the effects of chronic types of back pain, it accounts for 10.7% of all YLD. Neck pain and migraines/headaches account for approximately 24 million DALYs. Other musculoskeletal disorders cause 28 million DALY, and fall injuries cause 19 million DALY. Other important indicators include osteoarthritis (17 million DALY) and accident-related injuries (13 million DALY)^[13].

Given the psychosomatic approach to the interpretation of damage to the supporting system, it is worth noting that the basis of a healthy skeleton is the strength of one's beliefs and intentions^[18]. Accordingly, the rigidity of one's beliefs and behavior directly affects the mobility of their musculoskeletal system. The main symptom of problems with the musculoskeletal system is pain, which is the result of self-destruction and is caused by guilt. However, it is impossible to say this unequivocally since each case is different. It is necessary to consider the most common causes of pathological changes based on their localization in the body^[19].

Pain in the spine, namely in the cervical region, is characterized by stubbornness, rigidity, and unwillingness to consider other people's opinions. Pain in the thoracic region indicates taking on someone else's responsibility. Discomfort in the lumbar region is caused by experienced failures, resentments, fears, and pain in the coccygeal region correlates with the fear of success in life. Pain in the legs symbolizes how people move through life, that is, fears of the future. Problems with the hands are associated with feelings of guilt for the actions that a person does, especially acute problems are caused by actions that a person does despite themselves. Joint discomfort is associated with a change of area in life and with self-criticism, perfectionism, anger,

feelings of hatred, and lack of meaning in their activities. Knee damage occurs when a person refuses to go their way or when a person's interaction with others in society is disrupted, as well as with pride and punitive thoughts. The ankle joints and the joints of the foot are affected due to the inability of a person to choose their life path. The shoulder joint suffers when a person does not want to take responsibility for their actions in particular and life in general; not to fulfill the promises made by a person. The elbow joint is affected by a person's pathological desire to hold, control, accumulate, and manage something. Problems with the joints of the hand begin when a person wants to constantly monitor the workflow and interfere with it [19].

One of the main causes of disorders in the functioning of the musculoskeletal system is the consequences of a stressful situation, in particular stress associated with the performance of official duties. The main signs of stress are physiological factors (rapid pulse, pale skin of the face and body, excessive sweating), psychological factors (changes in the dynamics of mental functions, distraction, weakening of memory functions, decreased thinking

functions), personal factors (suppression of will, decreased self-control, the passivity of behavior, fear and anxiety), and medical factors (nervousness, hysterical reactions, headaches, insomnia, impaired functions of various organs and body systems)[9]. The stress response is based mainly on how a person perceives it – positively or negatively. Positive stress is a reaction to a situation that a person can cope with, negative stress is the opposite. Negative reactions to stress are associated with difficulties that a person cannot perform. They are closely related to feelings such as insecurity, disinterest, and anxiety. Negative reactions to stress are associated with psychosocial and physiological factors. If there is no correspondence between work requirements and the existing mechanisms that help the employee meet these requirements, the employee may experience stress-induced reactions that lead to deterioration of physical and psychological health. The stress reaction is a common cause of impaired functioning of the musculoskeletal system. The factors of stress occurrence at work are considered in detail in Table 3 [20].

Table 3) Psychological stressors in the work environment that cause physical disorders [20]

No.	Factor name	Importance of the factor	Consequences of dysfunction
1	Psychological support	Employees with psychological support have a greater commitment to working, job satisfaction, and a positive attitude	In the absence of withdrawal symptoms, conflicts, and overexertion are observed, which leads to physical discomfort and anxiety.
2	Organizational culture	It helps to improve the well-being of employees	An unhealthy culture adds stress at work, which worsens employees' condition
3	Clear leadership and expectations	Effective leadership increases employee morale, resilience, and trust, and reduces frustration and conflicts	The struggle for the right of management between employees of the organization negatively affects intermediate employees since each of them focuses on individual links of physical and psychological health, losing sight of the whole picture.
4	Politeness and respect	These qualities are associated with job satisfaction, a better perception of fairness, improved morale, and improved relationships with each other.	A lack of these qualities leads to emotional exhaustion of staff, more conflicts, bullying, and stress.
5	Psychological competencies and requirements	Matching requirements and qualifications minimize complaints of health, stress, and depression and increase self-esteem and job satisfaction	An imbalance leads to a depletion of energy and a decrease in mood and increased stress at work, which causes emotional stress.
6.	Growth and development	Employee development increases commitment to the goal improves employee's well-being and increases their motivation	Deterioration of health, boredom, low performance, conflict.
7	Recognition and reward	Increases employees' motivation, builds self-esteem and contributes to the success of both the team in general and each employee in particular.	Dysfunction undermines the employee's confidence in themselves and their work, and forms burnout and stress, leading to psychological and physical personality disorders
8	Engagement and impact	Increase of moral spirit and sense of self-pride, psychological well-being	Feelings of indifference and helplessness decreased self-esteem
9	Workload management	Freedom of decision-making increases job satisfaction, dedication to work	Development of physical, psychological, and emotional fatigue, increased stress, and tension.
10	Balance	Self-esteem, stress reduction, increased concentration, confidence, responsibility	Rapid fatigue, bad mood, illnesses, symptoms of depression, fears, anxiety, burnout
11	Psychological protection	Increases job satisfaction and productivity, minimizes health complaints and conflicts	Feelings of demoralization, stress, illness, exhaustion.

According to the data shown in the table, it can be stated that the psychological and physical state of a person is greatly influenced by the comfort of the social group in which they are situated. For work to be effective and employees to have a favorable emotional climate in the work environment, person

needs to feel that they belong to a common cause, and feel their value and importance. To take responsibility for their actions, be able to relax, and organize their workspace. In the opposite state, a person will experience ever-increasing tension, which can lead to a physical imbalance of the body,

and even to chronic diseases [20].

When considering the physical factors of stress, it is worth noting such criteria as intense, repetitive, or prolonged stress; awkward, extreme poses; the fast pace of work; repeated or prolonged activity; insufficient time to recover, vibration, or low (high) temperatures. Thus:

1. Inappropriate postures: the muscles and joints involved in the activity and the amount of tension or force that is carried or created are determined by the body posture, that is, when the back is bent, there is more load on the vertebral discs when lifting objects, handling them, or it decreases when the back is straight. Tasks that require prolonged or repeated twisting or flexing of the shoulders, wrists, hips, and knees also increase the load on the joints, which contributes to their rapid wear. Therefore, long or frequent work activities can be very stressful and require more time to recover.

2. Repetitive movements: frequent repetitive movements (such as every few seconds) and prolonged periods can lead to accumulated stretching of muscles, tendons, and fatigue. If the time allocated between exercises is sufficient, the muscles and tendons can recover from heavy loads and the effects of stretching. During inappropriate poses and heavy loads, the impact of repetitive movements due to performing the same work activity may increase. A risk factor, such as repetitive activities, may also depend on the particular action performed and the body area.

3. Duration: the time during which a person is constantly exposed to a risk factor is called duration. Work tasks that require the same movements or muscles to be used for a long time increase the likelihood of general and local fatigue. As a rule, if the period of continuous work increases (long muscle contraction is required to complete tasks), an additional period of rest or recovery is required.

4. Frequency: over a certain period, the number of repeated loads by a person is defined as the frequency. If the tension is repeated more often, the speed of movement of the tense part of the body increases. In addition, the recovery period is shortened when more frequent exercise is completed, and this increases the likelihood of general and local fatigue with duration [21].

After analyzing the main mental and physical problems that directly affect the body, it is important to provide recommendations for improving the person's condition. Notably, not only psychological prevention and correction will be effective in this case, but physical, ergonomic, and organizational criteria are also important. For organizational interventions in working conditions, it is effective to reduce daily working hours (for example, up to 6 hours per day). Additional breaks during long-term repetitive work have also proven effective. Another efficiency factor is shown by the use of ergonomic hand tools that reduce the load on

the shoulders, arms, and hands [22]. From the psychological standpoint, first of all, it is the identification, awareness, and elimination of the program that causes damage to the musculoskeletal system. Secondly, there is a need to take full responsibility for life (that is, learn to make choices in life). Thirdly, forgive oneself, accept oneself, and start loving oneself. "Loving yourself" means constantly working to improve the quality of one's own life [23].

It is possible to partially overcome the effects of stress (negative) and increase one's labor productivity through systematic stress management [24]. That is, during a targeted impact on the organization's personnel for the adaptation to stressful situations, to eliminate the source of stress itself and master particular methods of neutralizing it. There are two main methods of dealing with stress at work. The first one takes place at the organizational level, that is, it involves the diagnosis of stressful situations, and measures to prevent their occurrence [25]. The second one is at the level of employees, providing stress neutralization by the employee themselves using special correctional programs. Among them are time management methods (skills in planning one's activities), meditation, physical activity, and psychotherapy. Diet is also an important point in dealing with stress since, in stressful conditions, the normal diet is disrupted, so one needs to control their diet by including more vegetables and fruits [10].

Thus, considering the topic of psychosomatics of the musculoskeletal system, it is necessary to determine one of the main causes – of stress, namely – professional stress. Sometimes, workforces are in "stressful mode" all the time. The consequences of such a load cause physical harm to the body in general and the skeletal system (upper and lower limbs) in particular. The results of the study established that employees who were in the range of average indicators according to the stress detection method had a higher risk of musculoskeletal disorders. These rates were high even considering some variables, such as smoking, age, and body mass index scores. A key finding of the study is the identification of interdependent connections between stress caused by working conditions and reported musculoskeletal symptoms. The study opens opportunities for further study of the issue of psychosomatic disorders due to various social factors to establish causal relationships. The results of the study can also be used for disease prevention or health promotion programs (both psychological and physical) in the workplace in various professional groups.

In the work, stress was considered not only from a psychological but also from a physical standpoint. Physical criteria that can minimize negative effects on the human body have been described. Among them, the following were distinguished: body

position, repetitive movements, duration, and frequency. Particular recommendations were given for improving the psychological and physical condition of employees and methods of dealing with stress. Among the effective methods of control, specialists use the following: time management skills, meditation, a variety of breathing exercises, moderate physical activity, and psychotherapy (working with the emotional sphere in particular). Summarising the above, it is worth noting that stressful situations can cause devastating damage not only to the mental and physical health of the individual but also to the activities of the enterprise in general. Stress affects the most important resource of work – humans. Therefore, managers should consider the condition of their employees and introduce new working conditions considering and taking care of their health.

Conclusion

Musculoskeletal health is crucial for people's overall mobility, performance, and active involvement in all aspects of their lives, for maintaining an economic, and social life, and for a person's functional independence. Musculoskeletal health is an important indicator of life quality. Intense stress leads to disorders in the musculoskeletal system. In particular, such emotions as anger, frustration, annoyance, confusion, tension, hatred, anxiety, and nervousness cause stress. Not only the experience and frequency of such feelings but also the repetition of actions and movements cause injuries or disorders of the musculoskeletal system.

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