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Psychophysical Aspects of Public Health in the Oil and Gas Region

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Abstract

This study attempts to determine whether the prolonged stay of people in an unfavorable environment, in our case the oil and gas (OG) region, affects their psychophysical health, makes them vulnerable, prone to psychosomatic diseases, creates psychological problems, or leads to internal conflicts. Participants (typically healthy people) were asked to answer questions based on the multidimensional fatigue inventory (MFI-20). The scale reflects the following five main dimensions of fatigue: General fatigue, physical fatigue, reduced activity, mental fatigue, and reduced motivation. Three of them, namely general fatigue, physical fatigue, and mental fatigue, are of particular importance for this work. The study revealed the psychological profiles of the population of the study region and concluded that the OG region poses a significant risk to public health with all the ensuing consequences.

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Introduction

The ever-increasing need for energy resources leads not only to the expansion of oil and gas (OG) production but also to an increase in the extent of damage to the environment [1], [2], [3], [4], [5]. Oil production has a devastating effect on the population living in the OG region. The Human Rights Watch organization notes that oil-oriented development has caused severe environmental damage, destroying the livelihoods of many people living in oil-producing communities [6]. The influence of a number of unfavorable production factors on the state of public health against the background of developing fatigue contributes to a reduction in work safety, exposure to various diseases, and affects the quality of life.

US scientists believe that a special threat to the population living in OG producing regions is posed by infectious diseases to which locals have not developed immunities. For example, when workers arrived in the Urarina region in the Peruvian Amazon in the 1990s,

they were faced with the outbreak of various diseases, including pertussis and strains of malaria, which had never been observed in this community [6].

Russian and American studies, aimed at finding out how OG development affects the psychophysical health and, in general, the quality of life of oil workers, as well as the population of these regions, made it possible to conclude that oil workers have high levels of psychoemotional stress and anxiety, while residents have "socio-psychological" disorders. The most noticeable negative consequence in this case is stress, as a result of the prolonged effect of external adverse stimuli to the body, leading to nervous strain. It is noted that the development of oil fields carries a tendency for the prevalence of diseases of the peripheral nervous system, arterial hypertension, respiratory diseases, the risk of developing borderline mental disorders, etc. Long-term stress can potentially lead to a weakening of the immune system and create serious psychophysical problems in the form of fatigue (Verkuil *et al.*). It should be noted that in the case of fatigue, there is a change in the activity of the

reticular formation, maintaining the level of attention, perception, wakefulness and sleep, general muscle activity, and autonomic regulation. Therefore, extreme environmental requirements can exceed the resources of the human body and create threats to personal well-being. da Silva *et al.* believe that disasters caused by nature and by humans themselves are dangerous and can lead to psychological crises and suicide attempts. They identified three crisis contexts: Disasters, risk, and trauma [1], [7], [8], [9], [10], [11], [12], [13]. In the present study, the risk was taken as the basis. I.P. Pavlov argued that with prolonged exposure to pathological internal and external factors, the central nervous system inevitably depletes itself and its performance decreases sharply [14]. This condition is manifested by a decrease in performance and motivation, fatigue, emotional instability, and sleep disturbances.

At present, human mental health as a field of knowledge is left without due attention. It should be noted that one in four people during their lives might encounter mental health problems, which is fraught with grave consequences in the form of changes in the model of thinking and behavior [14], [15], [16], [17], [18], [19]. In this study, we made an attempt to determine the effects of the environment on the psychophysical state of public health in OG regions and to identify psychological profiles.

The purpose of this study is to determine whether the prolonged stay of people in an unfavorable living environment is reflected in their psychophysical health.

To achieve this purpose, the following tasks were identified:

1. To determine the susceptibility of study participants to various types of fatigue
2. To identify and describe the psychological profiles of the population of the study region.

Materials and Methods

To determine the psychophysical state of health and identify the psychological profile of the population of the OG region, the multidimensional fatigue inventory (MFI-20) scale was used. It was developed by Dutch scientists Smets *et al.* This technique is intended to obtain a subjective quantitative assessment of the overall severity of fatigue and its various aspects. The scale contains 20 statements designed to measure five fatigue dimensions: General fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue. Each dimension contains four elements that are rated on a 5-point scale. Scores are summarized, with the highest scores indicating more acute levels of fatigue. Table 1 shows a fragment of the MFI-20 scale.

Table 1: Fragment of the multidimensional fatigue inventory-20 scale

No	Statement	Answer	1	2	3	4	5	No, that is not true
1	I feel fit	Yes, that is true	1	2	3	4	5	No, that is not true
2	Physically I feel only able to do a little	Yes, that is true	1	2	3	4	5	No, that is not true
3	I feel very active	Yes, that is true	1	2	3	4	5	No, that is not true

This scale makes it possible to determine the significance level “p,” which shows the accuracy of the research results. Significance levels were recorded as decimal fractions (as 0.01). A low value for significance corresponds to a low probability that the experimental results are random. The questioning was carried out by specially trained medical specialists. The results allowed combining the data into homological semantic groups – profiles that reflect various characteristics of the severity or non-severity of fatigue dimensions. Table 2 shows the interpretation of fatigue dimensions.

Table 2: Key to the subjective fatigue rating scale

No	Fatigue dimensions	Scale answer numbers
1	General fatigue	1, 5, 12, 16
2	Reduced activity	3, 6, 10, 17
3	Reduced motivation	4, 9, 15, 18
4	Physical fatigue	2, 8, 14, 20
5	Mental fatigue	7, 11, 13, 19

Typically, the total number of scores should not exceed 20–30. Statistical processing was performed using the Statistical Package for the Social Sciences version 25 for Windows. According to the sample, the study involved the population of the West Kazakhstan region: Adults aged 18–50 years living near the Karachaganak field in Aksai – 246 people; Berezhovka – 188 people; and Uralsk city – 248 people (the control group).

In accordance with the research report, a self-questioning of the psychophysical state of public health was carried out with a visit to the place of residence of the subjects. The obtained data coincide with the literature on the impact of OG development on the psychophysical state of the population [1], [5], [6], [7], [8], [9], [10], [11].

Results

The statistical analysis of the data revealed the psychophysical state of the population of the study regions. The results are presented in Table 3.

When comparing the results for men in OG and control regions (CR) in terms of “general fatigue,” “mental fatigue,” and “reduced motivation,” as well as for women in terms of “general fatigue” and “reduced motivation,” statistically significant differences $p > 0.05$ were found. Table 3 shows that the psychophysical state of health of men and women in the study regions is statistically significantly different for all fatigue dimensions ($p > 0.05$).

Table 3: Quantitative self-report analysis of the population of the study regions by gender

Dimension	Gender	Group	n	Mean	Median	SD	p level
General fatigue	Male	OG	106	9.7	9.0	3.0	p>0.05
		CR	90	8.4	10.0	3.4	
	Female	OG	328	9.3	8.0	3.3	
		CR	158	8.9	8.0	3.9	
Physical fatigue	Male	OG	106	9.7	8.5	3.1	p>0.05
		CR	90	8.9	8.0	3.2	
	Female	OG	328	9.3	8.0	3.2	
		CR	158	9.3	8.0	3.6	
Reduced activity	Male	OG	106	9.6	9.0	2.9	p>0.05
		CR	90	8.9	8.0	3.3	
	Female	OG	328	9.3	8.0	3.3	
		CR	158	9.3	8.0	3.7	
Mental fatigue	Male	OG	106	9.8	9.0	2.7	p>0.05
		CR	90	8.5	8.0	3.0	
	Female	OG	328	9.5	8.0	2.9	
		CR	158	9.5	8.0	3.3	
Reduced motivation	Male	OG	106	9.4	8.0	2.9	p>0.05
		CR	90	8.3	8.0	3.3	
	Female	OG	328	8.9	8.0	2.9	
		CR	158	8.5	8.0	3.5	

OG: Oil and gas, CR: Control region.

Table 4: Fatigue dimension values of the subjective rating scale in the study regions

No	Dimension	Scale answer numbers	n scores			
			OG	CR	OG	CR
			Male	Male	Female	Female
1	General fatigue	1, 5, 12, 16	9.7	9.3	8.4	8.9
2	Physical fatigue	2, 8, 14, 20	9.8	9.5	8.5	9.5
3	Reduced activity	3, 6, 10, 17	9.7	9.3	8.9	9.3
4	Mental fatigue	7, 11, 13, 19	9.4	8.9	8.3	8.5
5	Reduced motivation	4, 9, 15, 18	9.0	9.3	8.9	9.3

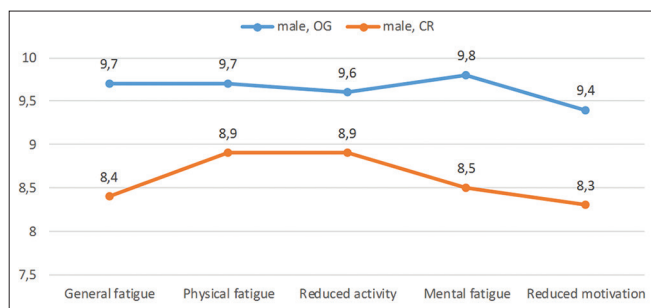


Figure 1: Quantitative male self-report values in oil and gas and control regions

For illustrative purposes, the data on fatigue dimension values by gender given in Table 4 are presented in the form of a diagram in Figures 1 and 2.

A comparison of the data (by the Mann–Whitney U test) revealed that there were statistically significant differences ($p > 0.05$) in terms of “general fatigue,” “reduced motivation,” and “mental fatigue” among men and in terms of “general fatigue” and “reduced motivation” among women in the study regions [20], [21]. According to descriptive statistics, the average score in the OG region was lower than in the CR.

Discussion

Based on data analysis, the psychological profiles of the population of the OG region were identified and described. Each profile has its own features that

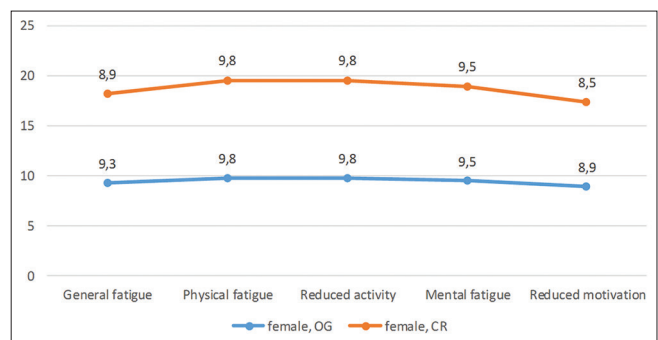


Figure 2: Quantitative female self-report values in oil and gas and control regions

characterize the psychophysical state of an individual. One should note the importance of understanding fatigue, given its adverse effects. Fatigue should not be confused with tiredness. Tiredness is a physiological phenomenon that occurs as a result of the depletion of energy reserves, a transient process, disappearing after rest, and not requiring medical assistance. Fatigue is a feeling of weakness and extreme tiredness, which is not associated with any load; it may arise in the state of rest and does not disappear after sleep. This feeling is most often psychogenic in nature, and in this case, a person might need medical assistance.

In the process of data analysis, there were difficulties in interpreting some items of the MFI-20. For example, such items as “I feel fit” (item 1), “I think I do very little in a day” (item 10), and “I am rested” (item 12) sound somewhat problematic. Difficulties arose when it was necessary to identify the cause of the psychophysical state of an individual: Whether it was associated with environmental influences or it was fatigue as such. In addition, item 20 “Physically,

I feel I am in an excellent condition” is probably more connected with general thoughts about one’s condition. Despite the difficulties noted, the values of the scale indicators were combined into two groups (profiles): Anxious and passive-aggressive.

“Anxious” is an emotional state characteristic of an individual prone to experiencing anxiety. Described by Freud, the term “anxiety” literally means “readiness for anxiety.” The state of anxiety arises in a situation when a certain irritant is perceived by an individual as a threat, danger, or harm, and can intensify in the case when a person does not understand the reasons for his or her poor health. Situations of uncertainty as well as adverse living and working conditions increase feelings of anxiety and fear, which can cause side effects. The steady state of anxiety leads to the constant production of stress hormones. A person starts to have frequent headaches, insomnia, and reduced physical activity. This is noticeable among women, especially of middle age, which can be associated not only with their attitude to changes in the environment but also with a sense of powerlessness, which creates potential health problems at the psychophysical level. The body weakens with age, which leads to the occurrence of endocrine diseases (diabetes, hypertrichosis, and bronchial asthma). In addition, there is a decrease in an individual’s adaptive mechanisms, i.e., in the level of psychophysical adaptation, which negatively affects his or her relationships in the external environment and leads to social diseases, such as the inability to create strong family ties, communicative behavior disorders, and emotional disturbances. According to neuroimaging data, the long duration of such a condition leads to organic changes in the brain, which may result in more serious consequences for an individual’s health [22], [23], [24], [25], [26].

Passive-aggressive behavior is characterized by indirect resistance to the demands of other people and the prevention of direct confrontation. The passive-aggressive behavior pattern was first described by Colonel William Menninger in relation to soldiers, whose behavior at first glance was not openly defiant, yet expressed aggression with passive measures – stubbornness, pouting, procrastination, and inefficiency. Menninger defined such behavior as “immaturity” as a reaction to “routine military stress.” According to Menninger, there are two groups of stress: Internal and external. Each of them carries either a challenge or a threat to the life of an individual, limiting his or her activity. In the case of soldiers, “immaturity” is an internal factor and “routine military stress” is an external factor. In our case, external factors include an unconscious impulse to action, which is manifested in actions in the emotional and communicative spheres. In our opinion, this is a result of the long-term environmental and, consequently, social disadvantage of the population living in the OG region. Internal factors include unconscious emotional experiences, accompanied by prolonged stress, which carries the risk of harming one’s own health. In

addition, people of this profile are characterized by an inadequate reaction to stress, such as distraction and irritable weakness. According to I.P. Pavlov, they involve pathological lability or explosiveness, increased anxiety, fear, which may not seem to be manifested in any way – these are signs of irrational behavior leading to social maladaptation, as well as a tendency to depression and fatigue. Such a condition is dangerous because under the influence of both external and internal factors and with an insufficient volume of compensatory reactions, it can transform into more complex clinical manifestations in the form of depressive symptoms, which contributes to the appearance of a premonitory state. In this situation, an individual is not always able to independently resist this [27], [28], [29].

Thus, the state of the environment in the OG region negatively affects the psychophysical health of the local population. This condition is aggravated by unfavorable living conditions, the feeling of helplessness, and the inability to influence the course of events. The discussion shows that the results of this study are supported by the existing literature on the influence of external factors on the psychophysical health of the population, which suggests that it depends on the state of the environment.

Conclusions

The research results made it possible to conclude that external factors (OG development), due to the region’s environmental destabilization, negatively affect the psychophysical state of health of the local population. This showed a comparison of two independent groups in the OG region and in the CR, which have significantly different values of fatigue ($p < 0.05$). It also became clear that the deterioration of the psychophysical state of the population of the OG region is associated with a feeling of inability to control the situation. Psychological profiles identified in practice have a direct correlation with the indicators of the MFI-20 scale ($p < 0.0$). An anxious profile was associated with mental fatigue and reduced motivation, while passive-depressive – with physical and general fatigue. The research data indicate that the study region poses a significant risk to public health.

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