

# NEUROTICISM AND ITS ASSOCIATION WITH CONSCIENTIOUSNESS AND BLOOD CREATINE KINASE IN SOLDIERS

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## ABSTRACT

The service of Soldiers is a high difficulty. For this reason, we conducted a research with the intention to analyze the impact of the services on the physical and psychological state of soldiers both in the short and long-term perspective. Based on the detailed analysis of the difficulty of services of the Armed Forces we will implement special precautions to reduce a negative impact of the service to their organism. A sample of 102 participants completed initial assessments of their current psychophysiological state. This paper describes finding a correlation between measured variables and their possible impact on fatigue experience. The Revised NEO Personality Inventory (NEO-PI-R) was used to assess participant's Big Five personality traits. Further, we carried out biochemical measurements of blood markers such as cortisol, urea, creatine kinase (CK), lactate dehydrogenase (LDH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), bilirubin and hematocrit (HCT). The body composition was estimated from the measurements of body height (BH), body weight (BW), total body fat (TBF), total body water (TBW), extracellular water (ECW), intracellular water (ICW), body mass index (BMI), bone mass (BM), skeletal muscle mass (SMM), left arm muscle mass (LAMM), right arm muscle mass (RAMM), left leg muscle mass (LLMM) and right leg muscle mass (RLMM). We correlated all of the variables and the results show the relationship between some of them. In particular, we found a negative correlation with neuroticism and conscientiousness ( $-0.58$ ) and more surprisingly with neuroticism and blood CK ( $0.21$ ). People with higher scores of neuroticism are likely to have a higher concentration of CK and vice versa. These results indicate a higher tendency to experiencing muscle and psychological fatigue for people with a higher rate of neuroticism. These results serve as indicators for identifying individuals more inclined to fatigue and requiring special attention and precautions in psychophysiological measures. It seems essential to start work with soldiers using psychophysiological methods to help them reduce fatigue and maintain the optimal state of their organisms during demanding situations and under real-life conditions as well. By the implementation of special measures, the training will be faster and cheaper, plus the number of absences due to illness will be lower.

**Keywords:** *Neuroticism, Conscientiousness, Creatine kinase, Fatigue, Soldiers*

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## INTRODUCTION

The soldiers are exposed to the stressful working environment due to erratic work hours, insufficient sleep and the associated fatigue. Irregular and rotating shifts including night services are an occupational stressor that has a negative impact on health and performance. These factors are causing a high difficulty in the service of soldiers.

Quality of sleep and sleep duration is an important factor influencing mental and physical readiness. Unfortunately, military sleeping conditions are less than ideal. Insufficient sleep and fatigue are potential risk factors for work-related accidents and it is a major contributing factor to operational errors [1].

This study is a part of a larger research project analyzing the impact of the services on the physical and psychological state of soldiers both in the short and long-term perspective. Our intention is to reduce a negative impact of the service to soldiers organism. The first part of the project focus on examining the current physical and psychological state of the Czech soldiers group. This paper describes finding a correlation between measured variables and their possible impact on fatigue experience.

To monitor responses to workload, we need reliable tools that make it easy the early diagnosis of working fatigue. Fatigue is a complex condition involving a strong and persistent form of mental or physical tiredness, weakness, exhaustion, and inability to concentrate [2]. It can influence soldiers well-being, productivity and health, which in turn can have negative effects on the soldier's organism and quality of work. **Physical fatigue** affects mobility, endurance and overall activity level. It includes feeling of a lack of energy and strength as it is related to muscle weakness. **Mental fatigue** includes lack of motivation, reduced concentration, memory loss and tiredness [2].

Experience with fatigue can be affected by individual differences [1]. Although there are no specific markers of impending working physical or mental fatigue, some psychological and biochemical indicators may be of value as predictors of stress resiliency and fatigue. Thus, we want to examine essential risk factors, such as personality traits and biochemical parameters, to determine how they are related to fatigue symptoms.

A promising biochemical marker of muscle fatigue seems to be creatine kinase (CK). CK is an enzyme catalyzing the conversion of creatine to creatine phosphate, that serves as a rapid energy reserve in the body. CK is expressed by various tissues, especially in the skeletal muscle, heart muscle and brain is in high concentration. CK is a sensitive biochemical marker of muscle fiber damage [3]. Monitoring of CK levels is important for assessing exercise intensity and regenerative capacity [4]. Elevated levels, but also occurs in many other conditions, such as physical exercise, muscle injury, pregnancy, malignancy, alcohol abuse, thyroid and parathyroid gland diseases, diabetes or medication . With intense physical stress, CK increases in most people [3], [4]. We predict, that people with a high score of neuroticism often experience muscle tension and due to they probably may be a higher level of CK.

Several risk factors have been shown to be associated with the onset and development of acute or chronic fatigue such as lifestyle and environmental factors; anxiety-depression symptoms and functional somatic conditions; personality traits, in particular neuroticism; persistent pain conditions and genetic factors [5]. Can any part of the fatigue dispersion be actually explained by the personality? The relationships between personality dimensions and fatigue examined a study indicated that low scores on extraversion, conscientiousness, neuroticism are predictors of higher fatigue scores [2]. The recent review synthesized studies investigating the relationships between personality traits and resilience revealed relationships between these two variables [6].

According to this review, resilience negatively correlates with neuroticism. Other Big Five dimensions positively correlate with resilience [6]. The results about the negative correlation between neuroticism and resilience is supported by the recent study examining the relationship between the personality traits of the five-factor model and fatigue among shift workers, which showed that neuroticism has a positive association with both physical and mental fatigue and it is the only trait that could predict physical fatigue [7]. If we focus on the relationship between personality traits and sleep quality, which is a factor influencing person's readiness or presence of fatigue experience, recent study assessing chronotype, sleep duration, and nightmare frequency in relation to the Big Five personality factors refers that neuroticism and increasing age negatively associate with sleep quality, whereas extraversion positively relate to sleep quality [8]. Results of mentioned studies suggest that there are measurable and consistent relations between physiology and personality, moreover, specifically neuroticism is a potential predictor of bad sleep quality, poorer resilience and consequently fatigue [9].

## **SUBJECTS**

A sample of 102 participants of the male sex with an average age of  $30.3 \pm 5.8$  completed initial assessments. All of them were men in a good physical and mental condition. About 50 % of this sample was in military service from 1 to 10 years, 35 % was in the service for more than 10 years and 15 % for less than a year. All

participants provided written informed consent with the research.

## **METHODS**

### ***THE REVISED NEO PERSONALITY INVENTORY (NEO-PI-R)***

We used personality inventory for the evaluation of psychological state of soldiers. The Revised NEO Personality Inventory (NEO-PI-R) is commonly used around the world to assess the individual's personality structure and development [10]. It has a long tradition in the research of generations of personality psychologists. NEO-PI-R provide the personality profiles to understand the strengths and weaknesses of the person. It is based on the fact that individuals differ in way of thinking, feeling and acting. This instrument consists of 240 items that assess 30 special traits that define the broad domains of the Five-Factor Model of personality: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness [10], [11], [12]. Each of mentioned five factors encompasses a number of more specific facets. *Neuroticism* includes factors such as anxiety, angry hostility, depression, self-consciousness, impulsiveness and vulnerability. *Extraversion* contains warmth, gregariousness, assertiveness, activity, excitement seeking and positive emotions. *Openness* is specified by fantasy, aesthetics, feelings, actions, ideas and values. Trust, straightforwardness, altruism, compliance and modesty are part of the trait called *agreeableness*. Competence, order, dutifulness, achievement striving, self-discipline and

deliberation determine **conscientiousness** [11]. In the following section, we will briefly describe the characteristics of the main domains of the Five-Factor Model of personality for a better understanding of possible connections between personal characteristics and fatigue experience.

The scale of **neuroticism** detects the individual differences in emotional stability and emotional instability [11]. This scale tells us how the person experiences the feelings of fear, depression, embarrassment. Negative emotionality as worry and guilt is characteristic of people with a high score of neuroticism, who describes themselves as an emotional unstable, full of concern, unsure, anxious, sad, nervous, angry, impulsive, intense [11], [13]. They have limited sources to control and manage stressful events. In contrary, people with a low score of neuroticism are emotionally stable, calm, balanced, carefree, relaxed and stress resistant. According the study investigating associations between personality and fatigue, high neuroticism is a significant predictor of both multiple sclerosis related cognitive fatigue and depression [14]. These findings are confirmed by Luciano et al. (2018), who found correlations between neuroticism and depressive symptoms [13]. Second factor called **extraversion** characterizes interpersonal behavior. People with a high score of extraversion are friendly, communicative, social, active, confident, energetic, optimistic, funny, talkative [11]. People with a low score called introverts are often shy, bold, reserved, hesitant, impassive, quiet, restrained, pessimistic, unsocial. **Openness to experience**

is less known than the previous ones. Openness is expressed by vivid imagination, sensitivity to aesthetic stimuli, perception of inner feelings, preference for diversity, curiosity and independent judgment, affects the level of passion for new experiences and impressions [11]. People with a high score of this scale are interested in new experiences and impressions, have rich fantasy, they are creative, original, inquisitive, thoughtful, liberal, independent, they describe themselves as intellectual and studious. Their sensitivity to the perception of positive and negative emotions is higher than people with a low score of openness, who are basically the opposite of people with a high score of this trait. They tend to behave conventionally, hold conservative attitudes, prefer well known, experienced and proven things and events before knew and unknown, their emotional reactions are less intensive, they are realistic, insensitive, unresponsive [11]. Another personality trait called **agreeableness** characterizes interpersonal behavior as already mentioned extraversion. The most distinctive characteristic of people with a high score of agreeableness is altruism, which includes kindness or understanding for others [11]. These individuals tend to trust other people, prefer cooperation with other people, they are tolerant, modest, polite, honest, self-sacrificing, trusting, tactful, compassionate, kind. They may be servile and humiliated towards others. In pathological form, extreme presence of these characteristic is a sign of dependent personality disorder [11]. People with a low score of agreeableness are egocentric, aggressive, authoritarian, despotic, conflicting, egoistic,

selfish, intolerant, aggressive, insidious, suspicious, selfish, tend to disregard the intentions of other people. The extremely low score may testify about antisocialness, narcissism or paranoid personality disorder [11]. The last trait called *conscientiousness* is described by Costa and Mc Craee (2004) as a kind of self-control related to active planning, organizing, and performing tasks. People with a high score of conscientiousness are determined, aspiring, productive, efficient, responsible, punctual, precise, purposeful, diligent, persistent, discipline, systematic [11]. These socially desirable characteristics are related to work success. On the contrary, people with low score of conscientiousness are lazy, inconsistent, hasty, impetuous, chaotic, careless, inattentive. According Brower et al. (2015) conscientiousness correlates with stress sensitivity. High conscientiousness predicts successful performance during and after stressful conditions [9].

## **DATA COLLECTION AND ANALYSIS**

Data was taken within a few days according to the group available for our data collection. We collected data of biochemical measurements, body composition and psychological state from available group of participants at once. First, the biochemical analysis was done because of the necessary determined time to collect a capillary blood sample. After that, the analysis of the participant's body composition was measured. These two measurements took together about 5 minutes per person. These measurements were

followed by psychological personality assessments which took approximately one hour. Psychological assessment was done in a separate room to ensure peace and quiet during the completion.

## **BIOCHEMICAL ANALYSIS**

The biochemical monitoring of the selected blood markers can help us to objectify the current state of soldiers. For all participants, a capillary blood sample was taken between 8 a.m. and 9 a.m. and immediately analysed for urea, bilirubin, creatine kinase (CK), lactate dehydrogenase (LDH), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) using a dry chemistry method (SPOTCHEM™ EZ SP-4430). Further, hematocrit (HCT) and hormone cortisol were measured in the blood sample. Hematocrit was analyzed using CritSpin™ Microhematocrit Centrifuge and Digital Reader. Hormone cortisol was measured by the enzyme-linked immunosorbent assay (ELISA).

## **BODY COMPOSITION**

The body composition analysis was assessed using bioelectrical impedance analysis (TANITA MC-780 MA) and was estimated from the measurements of body height (BH), body weight (BW), total body fat (TBF), total body water (TBW), extracellular water (ECW), intracellular water (ICW), body mass index (BMI), bone mass (BM), skeletal muscle mass (SMM), left arm muscle mass (LAMM), right arm muscle mass (RAMM), left leg muscle mass (LLMM) and right leg muscle mass (RLMM). The measurements of body

composition were performed between 8 a.m. and 9 a.m.

### **PSYCHOLOGICAL STATE**

To assess the psychological state on the basis of participant's Big Five personality traits the Revised NEO Personality Inventory (NEO PI-R) was used. The subjects described themselves through their answers on the appropriate questions, which are part of this inventory. The inventory consists of 240 items assessing 30 special traits that define the broad domains of the Five-Factor Model of personality as described above. Personality assessment took about one hour. We submitted a paper version of the test to all participants.

### **ANALYTIC PROCEDURES**

After the measurement, all collected data were processed and analysed. Data were analyzed using STATISTICA (StatSoft, CR), version 12.0.

### **RESULTS**

Our results are summarized in the Table I. First, the correlations between the mean of personality traits and mean of biochemical parameters were explored. We correlated all of the variables and the results show the relationship between some of them.

A negative correlation was found between neuroticism and conscientiousness ( $r = -0.583$ ,  $p = 0.000$ ). In other words, individuals with a high neurotic score have a low conscientious score and conversely, individuals with a low neurotic score have a high conscientious score. High neuroticism and low conscientiousness are frequently implicated in health-risk behaviors, such as smoking and overeating, as well as health outcomes, including mortality [15]. According to Costa and McCrae (2004) individuals with high neurotic score and low conscientious score are impulsive, reckless, epicurean, uncritical, unstable. They experience anxiety in situations where they are required to perform certain tasks [11]. They can experience a fear of losing as well as fear of winning, that is why they usually try to avoid the competitive situation. The threat of losing may aggravate their feelings of inability and compromise their self-esteem. The result of recent research examining the association with physiological markers of morbidity and mortality, such as inflammation revealed that high neuroticism and low conscientiousness were both associated with approximately 40% greater risk of exceeding clinically relevant thresholds of interleukin-6 often elevated in patients with frailty and chronic morbidity [15], [16]. It is evident, that this case of soldiers personality (high neuroticism and low conscientiousness) is unfortunate in terms of susceptibility to fatigue.

**TABLE I.** Associations between conscientiousness and biochemical correlates and neuroticism (N = 102)

Conscientiousness and Biochemical Correlate	Neuroticism	
	Pearson's correlation coefficient ( <i>r</i> )	<i>p</i> -value
Conscientiousness	-0.583*	0.000
Urea	0.137	0.170
Bilirubin	-0.087	0.383
AST	0.104	0.300
ALT	0.091	0.363
LDH	-0.002	0.987
CK	0.207*	0.037
HCT	-0.032	0.749
Cortisol	0.029	0.776

\*Correlation is significant at the 0.05 level

The opposite case of founding a negative correlation between neuroticism and conscientiousness is a low score of neuroticism combined with a high score of conscientiousness. People with low neuroticism and high conscientiousness score are performance-oriented, emotional stable, factual, discipline, not disturbed by their own emotion [11]. They set challenging tasks and they are capable to manage them. They know how to organize things. They are driven by a desire for success. Due to their emotional stability, determination, responsibility, perseverance, discipline, etc. they are effective even during stressful [9]. This type of personality is resistant to stressors whether it is an occupational, environmental or emotional stressor. Combination of low neuroticism and high conscientiousness seems to be ideal in terms of stress resistant soldier. The score of our average soldier is 66 for neuroticism and 129 for conscientiousness. From the spectrum very low, low, medium, high and very high. The value 66

for neuroticism corresponds to low neuroticism. The score 129 for conscientiousness corresponds to high conscientiousness.

The other possible combinations of these dimensions are high neuroticism and high conscientiousness or low neuroticism and low conscientiousness. People with high neuroticism and high conscientiousness are competitive and ambitious, however, they are worried about the results of their efforts [11]. They set challenging tasks, only because they believe they will look like more capable than they think they are if they complete the tasks. They are anxious, careful and purposeful. Obstacles and difficulties in achieving their goals cause fear and hostility in these individuals. It is obvious that a soldier with these qualities would not be successful and it is only positive that this combination of personality characteristics does not occur in our sample. In contrary, people with low neuroticism and low conscientiousness are noncompetitive, relaxed, informal and tolerant

[11]. They reject the usual ways of desire for success because they are not materialistic, they prefer to meet their own internal needs. As in the previous case, it is not desirable for such a combination of characteristics to occur with soldiers.

Positive correlation was found between neuroticism and blood CK ( $r = 0.207$ ,  $p = 0.037$ ). People with higher scores of neuroticism are likely to have a higher concentration of CK and vice versa. These results indicate a higher tendency to experiencing muscle and psychological fatigue for people with a higher rate of neuroticism. The results correspond to assumptions regarding neuroticism as a personality trait related to emotional stability, respectively instability and distress often correlate with disease presence and physical symptoms such as fatigue [17]. Emotional instability (neuroticism) is defined as a difficulty to cope with everyday problems, impulsivity, inability to control our desires and cravings, which is very tiring [11]. There is no wonder, that chronic emotional instability is typical of creates physiological changes detrimental to health and that increased neuroticism is associated with poorer mental and physical health [17], [13]. The biochemical results further showed, that levels of cortisol, CK, urea and bilirubin were significantly increased in comparison to reference limits. This suggests that military service implies an effect on the soldier organism. Monitoring these biochemical markers can be used to assess the current state and readiness of the member of the army for the service. Increased cortisol level associates with a higher risk of chronic stress,

while increasing CK level implies muscle fatigue and insufficient regeneration.

## **CONCLUSION**

The results of this study serve as indicators for identifying soldiers more inclinable to fatigue and requiring special attention and precautions in psychophysiological assessments. It seems essential to start work with soldiers using psychophysiological methods to help them reduce fatigue and maintain the optimal state of their organisms during demanding situations and under real-life conditions as well. The soldiers do not have a methodology available to reduce the negative impact of the service to the organism despite the high difficulty of the service. Therefore, the analysis of the impact of the services on the physical and psychological state of soldiers from the short term as well as long term perspective will be developed. The methodology will contain a special exercises and precautions focused on fatigue reduction, overload of the locomotive apparatus elimination and sleep optimization. By implementation of these measures, the training will be faster and cheaper plus the number of absences due to illness will be lower. Repeated psychological, biochemical and physiological analysis and the comparison with a reference group will reveal, if these precautions can improve the effect that has the difficult service on soldier organism. Based on these results specific exercise and recommendation may be applied to improve health, fitness and the

effectiveness of the specific military training program.

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