

Comparative analysis of psychophysiological states among Croatian and Ukrainian wrestling

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Abstract.

Problem Statement. The task of psychophysiological control is to obtain operational information about the state of the main characteristics and qualities of the athlete, which can be used to correct the training system. Psychophysiological control include of complex of assessments of personal-typological, sensorimotor, psychocogial and cognitive characteristics of the athlete. There is a need to develop a system for diagnosing of psychophysiological states and correction of deficits of adaptation process for elite athletes. **Purpose:** The aim of this study is to compare psychophysiological state among Croatia and Ukrainian wrestlers and add to a more holistic psychophysiological diagnostic in expert athletes. **Methods:** Participants are the elite Greco-Roman wrestlers and members of the national teams of Ukraine (20 athletes) and Croatia (12 athletes). The psychophysiological states of wrestlers were studied by a holistic methodological approach which includes: estimate of psychological state, balance of nervous process and functional mobility of nervous process. **Results:** The results indicated higher performance in visual perception and the ability of information processing speed of Ukrainian wrestlers compared to Croatian wrestlers. Differences have been observed as well in optimal impulsiveness, emotional stability and stress resistance that is less optimal Croatian wrestlers. Croatian wrestlers have an increased level of impulsivity and, as a result show low emotional stability. This may indicates possible spontaneous and premature actions of wrestlers. For Ukraine wrestlers arousal and fatigue management are future goals for improvement. **Conclusions:** We conclude that Ukraine Team should improve preparedness to training given the fatigue and arousal. For Croatian wrestlers emotional instability and improvement of visual perception need to be considered.

Keywords: psychophysiological state, elite wrestlers, diagnostic

Introduction

Modern sports activity is characterized to achievement of high sports result in competitions of different levels of athletes by optimizing the training process (Zhanneta et al., 2015). The improvement of performance elite athletes depends on increasing functional processes and psychological mobilization (Bohuslavska et al., 2021). Whereas there is a consensus that psychological support of elite athletes is important and a quite complex process research in yet still limited. Yet on a more practical level recommendations in performance often contain the following stages:

First, obtaining information about upcoming competitions and main competitors;

Second, diagnostics of the bodily and mental fitness level of an athlete at the different stage of preparation;

Third, determination of the goal, technique and tactics for the upcoming competition;

Fourth, developing a detailed competition strategies;

Fifth, producing a preventive strategy to overcome difficulties and unexpected obstacles in competitive activity;

Sixth, using methods to psychological improving the athlete's volitional qualities and methods of blocking psychological tension;

Seventh, activating personal and social motives for the upcoming competition.

Coaches and sport psychologist alike need for all stages reliable data about the psychological or psychophysiological states of the athlete. Recent overviews suggest that analysis of modern diagnostic is

required for the psychophysiological assessment in elite athletes training support (Raab et al., 2015; Furley et al., 2021). Such a psychophysiological approach reflects the requirements of optimization in professional sport. For instance, it is well known that all of the psychological manifestations and reactions in modern elite sport are supported and based in physiological mechanisms (Chernozub et al., 2019; Diel et al., 2021). This includes emotions, motivations, motor response on any perception and action in sport activity. In the following we will use wrestling as a test bed of such a holistic psychophysiological approach in diagnostic.

Modern Olympic wrestling in an important part of the combat sport and is characterized by the development of spectacular and intense fights (Cynarski et al., 2021; Mirzaei et al., 2018). The changes of rules of competition during the last ten years resulted in density and intensity of wrestling matches (Latyshev et al., 2021). In short, the new wrestling rules require to changes the system preparation in wrestling which requires an updated psychophysiological diagnostic. We argue that new data from such a diagnostic will reveal new recommendations about training and improvements of wrestling preparation for competitions (Mirzaei, Curby et al., 2011; Slacanac et al., 2017). One of the main components of wrestling training preparation should be based on scientific knowledge and support (Korobeynikov et al., 2021). In this paper we will focus on the measure and analyses of information for the athletes' functional and psychological state for the preparation of elite wrestlers. Traditionally the scientific support for wrestlers includes the use of physiological, kinesiological, biochemical and psychological methods of analyses (Starosta et al., 2014; Chernozub et al., 2018). Here we will focus holistically on the correction of the training process by the diagnostic of psychophysiological methods as recently has been advocated (Hoffmann et al. 2019). The study of psychophysiological functions may provide additional information for realistic estimated of the state of athletes. The psychophysiological functions such as neurodynamic, psychomotoric and cognitive processes are the basis of biological fundament of individual differences in persons and thus provide an avenue for individualized training recommendations. The psychophysiological functions reflect the ability of athlete of preparing special skills that are the basis of technical excellence. In addition, the psychophysiological functions are sensitive indicators of fatigue and deterioration of functional states with athletes. We do acknowledge that many types of comprehensive control in sports determining and interact with physiological, biochemical, psychological and pedagogical regulations and call for a holistic training of athletes (Pryimakov et al., 2016; Podrigalo et al., 2017). We will focus on a less researched one that is the least developed area of comprehensive control in high-achievement sports called psychophysiological control. The task of psychophysiological control is to obtain operational information about the state of the main characteristics and qualities of the athlete, which can be used to correct training. We believe this is very important for wrestling to optimize training processes and allow for individualized improvements. Psychophysiological control include of complex of assessments of personal-typological, sensor motor, psychical and cognitive characteristics of the athlete (Korobeynikov et al., 2021). There are different approaches to the duration of comprehensive psychophysiological control in sports.

From the above arguments we derive that there is a need to develop an algorithm for diagnosing of psychophysiological states and correction of deficits of adaptation process for elite athletes. This requires a cultural approach given that the Greco-Roman wrestling is developed by differences in the National Wrestling schools. All nations have their own national training and styles of wrestling. For example, Ukrainian style belt wrestling, Moldova style trynte wrestling, Georgian wrestling chida-oba, Uzbek wrestling kurash and others (Park et al., 2020). Those styles have been historically developed and now form the national sport schools of Olympic styles of wrestling. One of the popular styles is Greco-Roman wrestling. Modern Greco-Roman wrestling include different national schools: Swedish, Finnish, Bulgarian, Polish, Ukrainian, Kazakh, Uzbek, Germany, Croatian, American, and others. All of these schools have their peculiarities and benefits which we can understand by cross-cultural studies and use psychophysiological diagnostic for optimizing the training process. The Croatian wrestling school is represents of former so-called Yugoslavia school. But during the last decades the Croatian wrestlers established themselves in the international arena. Ukraine has always had an independent wrestling school. The legendary wrestler Ivan Piddubny (1871-1949) was born in Ukraine and for many years was the unbeaten wrestler in the world. The modern wrestlers from Ukraine have high achievements in the world wrestling arena. For the cross-cultural study we investigate psychophysiological state among Croatia and Ukrainian wrestling.

Methods

We examined elite Greco-Roman wrestlers, that are members of the national teams of Ukraine and Croatia. No apriority sampling estimates are used given this is a complete national team study. We tested 20 athletes of Ukraine National Team of Greco-Roman Wrestling (age 20-27) that have been examined during a training camp on Olympic Center "Koncha Zasp". In additionl we tested 12 athletes of Croatia National Team of Greco-Roman Wrestling (age 18-26) that were examined during a training camp at the Sport Center in Gospić city. The instrumental study was approved by the Ethics Committees for Biomedical Research with accordance the ethical standards of the Helsinki Declaration. Consents for research in writing were given by the athletes according to the recommendations to Ethics Committees for Biomedical Research.

The psychophysiological state of wrestlers was studied by complex methods which include: estimate of psychological state, balance of nervous process and decision making. More specifically, the psychological state was studied by the adaptive variant of the color test from Lusher. This test is sensitive to associate color preference and the psychological state of humans. We used the ranking and pair wise color comparisons as the level of analysis. The following parameters are used: psychical capacity, fatigue, anxiety, deviation from autogenously norms, eccentricity, concentricity, vegetative coefficient, heterogeneity, and autonomy.

The balance of nervous process indicates the relation between arousal and inhibition of the nervous system. We used the reaction to the moving object for determining the balance of the nervous process. The reaction to the moving object is a complex sensory motor reaction which in addition to sensor and motor processes includes complicated processing of a sensory signal by the nervous system. The following parameters are used: accuracy, stability, arousal and arousal trend. The decision making limits the abilities of athletes for perception and information procession from external stimuli. The response to visual stimuli was used as a method of estimate of decision making. The athletes are asked to choose the stimuli as fast as possible. The following parameters are used: dynamism, capacity of visual analyzer, limited time of information processing and impulsiveness. The listed methods are part of the "Multipsychometer-05" hardware-software diagnostic instrument. Statistical processing of the obtained results was performed using the "Statistica 12" software. Since the analyzed indicators were non normal distributed, the Wilcoxon rank sum test was used to determine the statistically significant difference between the samples. To present the data distribution, an interquartile range was used, indicating the first quartile (25% percentile) and the third quartile (75%).

Results

The results of the investigation of psychological state of elite wrestlers from Ukraine and Croatia Teams are presented in Table 1. Fatigue differences between the groups of wrestlers have been significant. The psychological fatigue may reflect the results of physical and emotional overstrain (Hosaini et al., 2015). Our study showed higher fatigue in wrestlers represented by the Ukrainian national team compared to the Croatian national team. In contrast the level of anxiety is higher in Croatian wrestlers. This differences of national teams maybe a consequence of the different training processes in these elite wrestlers and national teams.

Results indicate that the psychological state is complex and individual factors can influence the mental conditions of athletes. One of the main factors which influence the psychological and perceptual processes of elite wrestlers is based on training processes. The most important training regulations are intensity and volume of muscular load. Our obtained results reflect the increased fatigue in Ukrainian wrestlers and increased anxiety in Croatian wrestlers potentially due to training load.

The results in addition reveal that eccentricity in Croatian wrestlers is significant larger than in Ukrainian wrestlers. The presence of significantly higher eccentricity in Croatian wrestlers may indicate insecurity and dissatisfaction with the present situation and would require follow-up diagnostic for appropriate recommendations. Our interpretation of the results is supported by high values of vegetative coefficients in Croatian wrestlers. We argue that the obtained results indicate high activity of the sympathetic autonomic nervous system in Croatian wrestlers that maybe caused possibly due to strain and anxiety.

Table 1. The variables of Color Test of Lusher in elite wrestlers of Croatian and Ukrainian Teams (median, lower and upper quartiles)

Variable	Croatia Team	Ukraine Team
Psychosocial capacity, conditional unit	10.84 7.34; 13.63	10.36 8.54; 12.67
Fatigue, conditional unit	2.36 1.53; 4.45	3.73* 1.45; 5.76
Anxiety, conditional unit	2.62 0.23; 5.67	1.57* 0.16; 4.56
Deviation from autogenously norms, conditional unit	14.54 8.34; 22.83	15.73 10.63; 19.78
Eccentricity, secret unit	9.56 4.63; 12.96	8.84* 6.67; 10.73
Concentricity, conditional unit	8.52 6.67; 9.87	8.52 6.76; 10.78
Vegetative coefficient, conditional unit	16.65 9.74; 19.87	14.43* 11.32; 17.87
Heteronomy, conditional unit	7.43 5.65; 8.54	6.50* 5.65; 8.53
Autonomy, conditional unit	10.87 8.76; 11.45	10.34 8.54; 11.51

Legend: * p =.05, for the Teams differences of wrestlers

The presence of low level of heteronomy in Ukrainian wrestlers indicates independence of behavior of those athletes. The increasing level of heteronomy in Croatian wrestlers may reflect compliance, compromise, humility and avoidance of failures.

In sum, the psychological state in elite wrestlers of different countries reflects the various effects of training process. For instance, high level of fatigue was observed in Ukrainian wrestlers. However the level of vegetative tension in Ukrainian wrestlers was lower than in Croatian wrestlers. It is consistent with low level of anxiety, eccentricity heteronomy in Ukrainian wrestlers in comparison to Croatian wrestlers. This indicates the presence of relative psychological comfort in wrestlers. The Croatian wrestlers are characterized by high level of anxiety, strain of autonomic nervous system and dissatisfaction with the present situation. This situation leads to search for compromise, humility and failure avoidance.

Table 2 presents the variables of balance of nervous process in elite wrestlers of Croatian and Ukrainian Teams. The results showed that between Croatian and Ukrainian wrestlers stability, arousal and arousal trend variables are different. Detailed analysis of results indicates the variables of stability in Croatian wrestlers are higher than in Ukrainian wrestlers.

The indicator of stability indicates balanced processes of excitation and inhibition in the nervous system. In sum, the large stability in Croatian wrestlers may be due to balanced arousal and inhibition processes of the nervous system during test fulfillment. This fact correlated with indicator of arousal which is higher in Ukrainian wrestlers than in Croatian athletes. We argue that the Ukrainian wrestlers have a high level of arousal in the nervous system.

Table 2. The variables of balance of nervous processes in elite wrestlers of Croatian and Ukrainian Teams (median, lower and upper quartiles)

Variable	Croatia Team	Ukraine Team
Accuracy, conditional unit	2.74 2.01; 3.35	2.88 2.51; 3.66
Stability, conditional unit	3.90 3.16; 4.54	3.18* 2.73; 4.05
Arousal, conditional unit	-0.02 -0.42; 0.15	-0.67* -1.37; 0.16
Arousal trend, conditional unit	-40.24 -111.50; 40.95	-77.85* -209.00; 42.11

Legend: * p =.05, for the Teams differences of wrestlers

The test of balance of the nervous system as characterized by the assessment of complex of visual motor reactions is another important diagnostic. In this task the person must respond to a moving object and respond by a button press. The obtained results point out balance between arousal and inhibition processes of the nervous system in Croatian wrestlers. In contrast, in Ukrainian wrestlers the processes of high arousal of the nervous system is evident. Table 3 present the results of the study of decision making in elite wrestlers of Croatian and Ukrainian teams. Analysis of results reveal the significant increase of the level of capacity of the visual analyzer test in Ukrainian wrestlers. This testifies the improved abilities of visual perception of information processing in Ukrainian wrestlers in comparison to Croatian athletes.

Table 3. The variables of decision making in elite wrestlers of Croatian and Ukrainian Teams (median, lower and upper quartiles)

Variable	Croatia Team	Ukraine Team
Dynamism, conventional units	72.34 68.45; 81.2	72.75 65.77; 82.49
Capacity of visual analyzer, conventional units	1.68 1.53; 1.75	1.84* 1.69; 1.97
Limited time of decision making, ms	410 380; 470	335* 305; 410
Impulsiveness, conventional units	-0.05 0.11; 0.08	-0.03* -0.11; 0.03

Legend: * p =.05, for the Teams differences of wrestlers

Obtained results indicate time of decision making. The visual performance to perception and information processing is very important for wrestling activity. The athlete must process perceptual information from the environment such as the current competition condition, actions of opponent wrestlers, referee's signals and enable fast decision making during the fight.

The speeded information processing in Ukrainian wrestlers indicates the increase of speed of information processing and decision making during fights. The slower time of information processing in Croatian wrestlers indicates the reduction of information processing performance.

A further analysis indicates higher impulsiveness in Croatian wrestlers. In contrast, among Ukrainian wrestlers indicate low impulsiveness. The variable of impulsiveness is characterized at the level of emotional stability and shows the presence or absence of unprepared, spontaneous and premature actions of athletes.

High impulsiveness in Croatian wrestlers reflects the unprepared, spontaneous and premature actions of wrestling and emotional instability. In Ukrainian wrestlers the results are indicators of an optimal level of impulsiveness and emotional stability. This may explain high stress resistance of elite Ukrainian wrestlers.

In sum, the investigation of functional mobility of the nervous system allows differences between elite wrestlers of Croatia and Ukraine teams. The Ukrainian wrestlers are characterized of higher ability of visual perception and information processing speed. Besides Ukrainian wrestlers have optimal impulsiveness, emotional stability and stress resistance in comparison to Croatian wrestlers.

The Croatian wrestlers show lower abilities for visual perception and information processing speed. Unlike Ukrainian wrestlers, Croatian wrestlers have an increased level of impulsivity and as a result low emotional stability. This fact may produce spontaneous and premature actions of wrestlers. For a more complex pattern of associations between psychophysiological variables correlation analyses were used. The correlation analysis revealed that among Croatian wrestlers reliable coefficient between parameters psychological state and neurodynamic characteristics (balance and mobility of nervous processes) exists.

In Figure 1 results of correlation analyses between psychological and neurodynamic characteristic of elite Croatian wrestlers are presented.

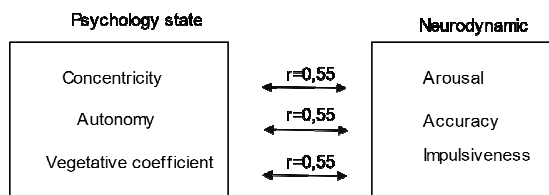


Fig 1. The results of correlation analyses between psychological and neurodynamic characteristic of elite Croatian wrestlers

The significant correlation coefficient between concentricity and arousal ($r=0.05$) indicates that athletes may focus on internal states and increase the arousal of the nervous system. The correlation link between vegetative coefficient and impulsiveness ($r=0.53$) show the predominance of the effects of sympathetic (ergotropic tone) which results in thoughtless actions and high energy expenditure. The correlation between variables of autonomy and accuracy reflects the compensation of increased arousal and impulsiveness and shows independence from external influences and improvement of response accuracy in choices of visual stimulus.

In sum, the correlation between psychological states and neurodynamic functions testifies increased arousal and impulsiveness with simultaneous improvements of accuracy in Croatian wrestlers.

In Figure 2 the results of correlation analyses between psychological and neurodynamic characteristic of elite Ukrainian wrestlers is presented.

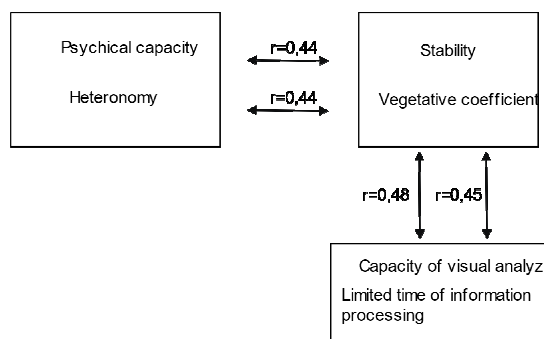


Fig 2. The results of correlation analyses between psychological and neurodynamic characteristic of elite Ukrainian wrestlers

The analysis revealed a significant correlation between stability and psychological state (psychological capacity, $r=0.44$; heteronomy, $r=0.45$) in Ukrainian wrestlers. This result indicates a link between balance of nervous processes and psychological performance with a focus of athlete towards information from the environment. The correlation analyses shows the relation between arousal and information processing performance in Ukrainian wrestlers (capacity of visual analyzer $r=0.48$ and limited time of information processing $r=0.45$). Reversed results indicate the link between arousal and perception and information processing speed. Thus, correlation analyses indicate the relationship between psychological state and balance of processes arousal and exhibition. Simultaneously arousal correlates with information processing performance in Ukrainian wrestlers.

Discussion

According to definitions the psychophysiological characteristics of athletes we tested three levels of brain activity: state of sensory perception, mechanisms of analyses and information processing and psychomotor realization (Naqvi et al., 2006; Raab et al., 2020; Herman et al., 2021).

The modern Olympic wrestling developed as a spectacular sport by improved performance throughout the globe. The national school of wrestling as compared in this study between Ukraine and Croatia national teams provide insights into the psychophysiological processes that may be partly impacted by the knowledge of the sport science systems and training processes (Linde et al., 2007).

The diagnostic of wrestling teams from different countries is a good testbed for understanding the consequences of experience and training processes on the psychophysiological states of elite wrestlers. The current study thought to improve preparedness for competition in wrestling using objective diagnostic of functional and psychological state of elite wrestlers (García-Pallarés et al., 2011; Zadorozhna et al., 2021). Given that psychophysiological state is a key part of functional diagnostic of elite athletes the proposed psychophysiological diagnostic may in the future help to inform the training process in wrestling.

Results of our study provide differences in the psychophysiological state among elite wrestlers of Croatia and Ukraine using objective methods of psychophysiological state of wrestlers.

Given the reliable and systematic differences obtained in the color test of Lusher (psychological state), visual motor reaction of moving object (balance of the nervous system), and visual motor responses on deciding between different stimulus (decision making) and of heart rate variability we believe that these measures should be part of future diagnostic in wrestlers.

Croatian wrestlers in comparison to Ukraine wrestlers showed higher level of anxiety, strain of the autonomic nervous system and dissatisfaction with the present situation. We argue that the high anxiety scores relate to high level impulsivity and low emotional stability in wrestlers and could be a leverage point for future interventions targeting towards emotional regulations strategies. As optimal emotional regulation has positive effects as well on visual perception and information processing speed this approach may have a general positive performance gain. Obtained results corresponded with previous empirical findings (Terres-Barcala et al., 2022), which showed the relation between impulsiveness and competitive anxiety for instance in female athletes providing a complex psychophysiological relation such as between arousal and inhibition process of the nervous system in Croatian wrestlers.

The current study found for Ukrainian wrestlers psychological comfort and optimal state of the autonomic nervous system. The prevalence of arousal in the nervous system and a quite satisfying high level of visual perception and information processing speed. We argue this is partly due to optimal impulsiveness and emotional stability and individual differences may help in the future to optimize psychophysiological states for each athlete even better. We are aware that we discussed our findings mainly on correlation analyses that showed improvements of quality of information processing with simultaneous increasing of arousal and impulsiveness in Croatian wrestlers and information processing performance with processes of arousal and exhibition in Ukrainian wrestlers. Future causal and experimental studies way reveal a theoretical and empirical understanding of these relations.

Conclusions

The psychophysiological state in elite wrestlers of Croatian and Ukrainian Teams reflects the various effects of training processes. Under conditions of fatigue the Ukraine wrestlers remain to have psychological comfort. The Croatia wrestlers revealed high levels of anxiety, strain of the autonomic nervous system and dissatisfaction with the present situation. The prevalence of arousal of the nervous system in Ukrainian wrestlers is compensated by the high level of ability of visual perception and information processing speed. In Croatian wrestlers the high level of anxiety relate to impulsivity and low emotional stability in wrestlers. Moreover the abilities for visual perception and information processing are reduced. Thus, preparedness to training for the Ukraine team should be considered when having high fatigue and arousal levels. For Croatian wrestlers we may take into account the emotional instability and improvement of visual perception.

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