

COACHING & KINESIOLOGY

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Tactical Styles of Fighting and Functional Asymmetry of the Brain Among Elite Wrestlers

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Key words: tactical styles, fight, functional asymmetry of brain, elite wrestlers

Abstract

Purpose – to investigate the relationship between functional brain asymmetry and tactical competition strategies among elite level wrestlers.

Methods. Examination of thirty elite athletes (Ukrainian Greco-Roman National Team members), aged between 20 and 28. In order to determine the dominance of cerebral hemisphere, the dependence assessment test was used (test version «Color & Word Test»; J.R. Stroop, 1935). Level of psycho-emotional stability (stress resistance) and functional mobility of nerve processes was determined in accordance with the results of the psycho-diagnostical complex «Multipsychometr-05». Statistical analysis of data was conducted by using the «Statistica 6» software package using methods of non-parametric statistics.

Results. The results found that an offensive style of wrestling among elite level wrestlers is related to the presence of brain hemisphere symmetry ($p < 0,05$), field independence from external stimuli ($p < 0,05$), high stress resistance ($p < 0,05$) and high speeds of perception and of processing information ($p < 0,05$). A defensive style of wrestling among elite level wrestlers is characterized by functional brain asymmetry with dominance of the right hemisphere ($p < 0,05$), field dependence from external stimuli and high throughput neurodynamic processes capacity ($p < 0,05$). The combined style of wrestling among elite level athletes is characterized by functional brain symmetry and field independence from external stimuli ($p < 0,05$). At the same time, the combined style indicates lower level of stress resistance ($p < 0,05$), combined with emotional stability and optimal lability of nervous system ($p < 0,05$).

Conclusions. Interconnection between styles of fighting among elite level wrestlers and characteristics of functional brain asymmetry was identified.

Introduction

Nowadays martial arts attract more attention from athletes, media sources, potential sponsors and partners. The International Olympic Committee pays attention to Olympic styles of wrestling, especially to Greco-Roman style, as it is considered as the first ever type of martial art in the history of Olympic Games. United World Wrestling, as an International Wrestling Federation, strives to make wrestling competitions more spectacular and attractive.

Therefore, the number of competitions significantly increased among all age groups [Dokmanac *et al.* 2016; Tunnemann *et al.* 2016]. At the same time a variety of martial arts has evolved, which compete among themselves in terms of popularity and mass participation. Professional types of martial arts, in comparison to Olympic styles, develop rapidly through modern commercial strategies, attracting more financial resources, which contribute to the dynamic development of non-Olympic sports [Kostorz *et al.* 2016; Arziutov *et al.* 2016].

Wrestling is considered as one of the oldest types of sports, but there was a threat of wrestling exclusion from Olympic Games program (decision of International Olympic Committee from 2013 to exclude all styles of wrestling from Olympic program).

Since it was necessary to increase popularity and make wrestling more spectacular, United World Wrestling has been changing the rules for Greco-Roman, Freestyle and Female wrestling styles within last four years. Mainly those changes affect wrestlers' motivation to apply more effective and high amplitude technical actions. In addition, referees motivate activity during the wrestling bout and sanction passivity of wrestlers.

Therefore, there is a need to review general preparation system, psychological and tactical preparation for elite level wrestlers [Mirzae *et al.* 2009; Barbas *et al.* 2011; Tropin *et al.* 2013; Curby 2016].

Among the latest research of leading experts in wrestling, there is a tendency towards the development and correction of training systems of elite wrestlers, considering competitions rules changes [Lopez-Gonzalez *et al.* 2013; Yamashita *et al.* 2017]. Several studies have been completed in the area of functional preparation of elite level wrestlers in the current conditions. [Mirzaei *et al.* 2012; Sybil *et al.* 2018]. Among wrestling experts, several studies were conducted, related to motivational aspects in psychological preparation of wrestlers [Martins *et al.* 2017; Korobeynikov *et al.* 2017].

Previous researches of several authors indicate the importance of individual and typological qualities, consideration athletes' technical skills mastering and formation of tactical strategies for wrestling bouts [Radchenko 2010; Iermakov *et al.* 2016; Podrigalo *et al.* 2017].

Traditionally the tactical styles of wrestling are related with attack or defense of technical activity during competition [Tropin *et al.* 2015]. Withal some authors link the tactical activity of wrestlers with times parameters of fighting techniques of wrestling [Radchenko 2010; Lopez-Gonzalez *et al.* 2013]. But the abilities to realization of technical skills in fight are related with psycho-emotional states of athlete [Korobeynikov *et al.* 2019].

One of the genetically determined individual-typological attributes is the functional brain asymmetry. Functional brain asymmetry determines not only characterological qualities of individual, but also impacts behavior and motivational activity of athlete [Wolf *et al.* 2015; Kuzmichev *et al.* 2018].

However, the lack of the research, related to interrelation between functional brain asymmetry and tactical competition strategies of elite wrestlers, induces to study this issue.

Purpose: To investigate the relationship between functional brain asymmetry and tactical competition strategies among elite level wrestlers.

Methods

Participants

Examination of thirty elite athletes (Ukrainian Greco-Roman National Team members), aged between 20-28.

Measures

In order to determine the dominance of cerebral hemisphere, dependence assessment test was used (test version «Color & Word Test»; [Stroop 1935]). Essentiality of the test is related to reaction on 3 verbal-colored irritants: color, letters and color names (understanding). The test procedure consists of a sequenced signals appearance in the center of the screen – the word «red» and «green», each of them can be written either in red color or in green. In addition, below the signal word, with relative appearance, neutrally colored word displayed (conditioned sign), which determines responding way: «understanding» or «color». There are only 8 available combinations of 3 variables. The task of the subject is to respond to the signals in accordance with conditioned sign, where the «red signal» always corresponds to the right button and «green signal» to the left button. If conditioned sign «understanding» is displayed, then the «red signal» would be the word «red», regardless of color of written letters. If conditioned sign «color» is displayed, the «red signal» would be the word written in red, regardless of the understanding features (color, which reflects to it). Based on the results the following indicators are being determined: field dependence, left hemisphere dominance, functional asymmetry and general effectiveness.

The level of psycho-emotional stability (stress resistance) was determined in accordance with the results of the «Stress test», which is associated with processing information based on the positional subject's selection in the corresponding cells in adapted mode. During the test, a certain time limit was set for selection of subjects, which simulates psycho-emotional strain. Based on the test results the following indicators were determined: stress resistance, throughput capacity and impulsiveness [Korobeynikov *et al.* 2018].

To study functional mobility of nerve processes, maximum rate for information processing during differentiation of stimuli estimation methodology was used. Monitor displays stylized image of traffic light, on which severally in random order red, yellow and green colors appear. Subject's task is to push right button in response to red signal, to push left button in response to green signal, and to skip pushing in response to yellow signal in maximum pace. Current test determines following indicators: dynamics, throughput capacity, maximum capability of information processing and impulsivity.

Procedure

All above-mentioned methods are the components of hardware-software psycho diagnostic complex «Multipsychometr-05».

Each tested athlete had to fill in a questionnaire prior to the test, which contained question about consent or disagreement to use test results in scientific research purposes. Written consents for research conduction were received from all athletes, in accordance with recommendations of biomedical research ethics committee.

Statistical analysis

Statistical analysis of data was conducted by using software package “Statistica 6”. For authentic differences assessment, methods of non-parametric statistics, based on Wilcoxon sign sum test, were used. To demonstrate the distribution of data, interquartile range was used, to indicate first (25% percentile), and third quartile (75%).

Results

In the table 1 the results of “field independence” test among elite level wrestlers with different tactical styles of wrestling are represented.

Based on the analysis results, considering indicator of field independence, wrestlers using defensive style have significantly lower values (Table 1).

According to classification of field independence indicator, absolute values decrease, which indicates dependence increase in perception and information processing from external stimuli [Korobeynikov *et al.* 2017]. Based on this, defensive wrestlers, when analyze and make decision during the bout, mainly depend on external factors. Competition conditions and coaches in the corner can be considered as external factors. At the same time, wrestlers with offensive style are less dependent on external factors when perceive and process information

The analysis of the left hemisphere prevalence demonstrated, that lowest values of indicator were observed among defensive wrestlers (Table 1).

Indicator’s classification of «left hemisphere dominance» shows absolute values decrease from 0,9 and lower, which gives evidence about explicit right hemisphere dominance. Absolute value indicator increases up to 1.15 indicates the presence of cerebral hemisphere symmetry while perceiving and processing information [Korobeynikov *et al.* 2017].

Based on the above-mentioned findings, right hemisphere dominance is observed among wrestlers with a defensive style of wrestling. While among wrestlers with an offensive and combined styles of wrestling, cerebral symmetry can be observed.

Analogical result can be observed based on the functional asymmetry indicator (Table 1). Thus, reliably reduced values of «functional asymmetry» indicator among wrestlers with defensive style, indicates presence of functional brain asymmetry with a prevalence of right hemisphere dominance. While wrestlers, with offensive and combined style of wrestling, demonstrate brain hemispheres symmetry, which means that analysis and processing of information occur in both brain hemispheres.

The analysis of overall efficacy of the «Field Dependence» test demonstrates veracious differences between three groups of athletes (Table 1). Lowest value indicators of «general efficacy» were found in the group of wrestlers with combined style of wrestling, while highest among wrestlers with defensive style. Since the indicator of «general efficacy» characterizes the general time of test completion, decrease in absolute values indicates speed increase of information processing, and decision-making accordingly. In this case, the highest decision-making speed was found among wrestlers with combined style of wrestling, while the lowest among wrestlers with defensive style.

Thereby, it can be noted, that presence of functional asymmetry of cerebral cortex of the brain hemispheres has a connection with tactical style of wrestling among elite level athletes. Considering, that functional brain asymmetry is genetically determined characteristic, it can be assumed, that formation of wrestling style occurs based on this feature.

Table 1. Results of the «Field independence» test among elite level wrestlers with different styles of wrestling (median, lower and upper quartiles, n=30)

Variables	Tactical styles of wrestling		
	Attack (n=12)	Defense (n=7)	Combination (n=11)
Field independence	0,93 0,82; 1,03	0,76* 0,68; 0,78	0,88** 0,79; 0,94
Left-hemisphere dominance	1,09 0,89; 1,36	0,83* 0,65; 1,09	1,03** 0,94; 1,11
Functional asymmetry	12,62 11,47; 13,10	7,65* 7,41; 7,89	10,78** 8,86; 13,13
Overall efficiency, ms	1713,16 1642,75; 1800,27	2724,36* 1774,64; 3500,72	1500,62** 1300,47; 1539,54

Notes: * - $p < 0,05$, for concerning to attack style of wrestling

Wrestlers with prevalence of offensive wrestling style demonstrate relative independence from external stimuli and have definite brain hemispheres symmetry. This can be observed in fast perception and information processing in decision-making conditions. Analogical tendency can be found among wrestlers with combined wrestling style, with only one differentiation – medium level of field dependency from external stimuli.

Wrestlers with defensive style of wrestling demonstrate higher dependence from external stimuli, considering obvious dominance of right brain hemisphere. At the same time current feature is reflected on deceleration of perception and processing information speed among wrestlers with defensive style. It can be assumed, that increasing in time for information processing among wrestlers with defensive style related to the right brain hemisphere dominance, in comparison to wrestlers with combined and offensive styles. It is obvious, that availability of the field dependence from external stimuli among wrestlers with offensive and combined styles enables acceleration of senso-motoric response, as a result of right hemisphere dominance.

Obtained typological features of the field dependence among wrestlers with different styles of wrestling appear in different environmental conditions, especially under the stress, which can be conditioned by competition activity. Credibly, stress resistance, as a characteristic determined by genetic factors but formed in a certain condition as a result of external factors influence, has relation to the style of wrestling.

Results of the «Stress Test» among elite level wrestlers with different styles of wrestling demonstrated in the table 2.

Obtained results show significantly lower absolute value indicators of stress resistance among athletes with combined style of wrestling, in comparison to wrestling with other styles (Table 2). Current fact demonstrates a higher level of stress resistance among wrestlers with offensive and defensive styles of wrestling. Significantly lower level of impulsivity indicator was observed among wrestlers with combined style of wrestling, which indicates lower amount of spontaneous and unprepared motor actions, as a compensatory mechanism of stress resistance prevention. Increased absolute impulsivity values among wrestlers with offensive and defensive styles of wrestling are related to the high excitation level of nerve processes, as an emotional response to the relevant stress factors.

In our previous studies, it was identified that high impulsivity level characterized by emotional instability, while decrease of impulsivity level shows increase in emotional stability among athletes [Korobeynikov 2018].

Thus, combined wrestling style among elite level wrestlers is characterized by stress resistance level decrease, and compensatory increase of emotional stability level accordingly.

Table 3 represents test results of the «Functional mobility of nervous processes» among wrestlers with different styles of wrestling.

The analysis of revealed results explains, that higher values of dynamics indicators observed among athletes with combined style of wrestling (Table 3). This fact shows optimal lability of the nervous system and ability to perceive information, to analyze and make decisions.

At the same time, higher indicator of throughput visual analyzer capability was observed among wrestlers

Table 2. Results of «Stress Test» among elite level wrestlers with different styles of wrestling (median, lower and upper quartiles, n=30)

Variables	Tactical styles of fighting		
	Attack (n=12)	Defense (n=7)	Combination (n=11)
Stress Resistance (secret unit)	99,18 87,50; 118,12	96,12 79,01; 111,58	88,79*** 87,84; 125,12
General Efficiency (secret unit)	1,12 1,10; 1,17	1,15 1,08; 1,15	1,01 0,86; 1,14
Impulsiveness (secret unit)	-0,01 -0,05; 0,03	-0,04 -0,12; 0,02	-0,05* -0,06; -0,04

Notes: * - $p < 0,05$, for concerning to attack style of wrestling

Table 3. «Functional mobility of nervous processes» among wrestlers with different styles of wrestling. (median, upper and lower quartiles, n=30)

Variables	Tactical styles of fighting		
	Attack (n=12)	Defense (n=7)	Combination (n=11)
Dynamism, secret unit	63,54 26,46; 75,32	74,63 67,79; 81,76	80,53* 67; 85,43
Capacity of the visual analyzer, secret unit	1,76 1,63; 2,27	1,94* 1,86; 1,97	1,82 1,74; 1,85
Limited speed of information processing, ms	320,48 260,27; 380,28	320,41 320,72; 350,83	350,63 320,73; 410,92

Notes: * - $p < 0,05$, for concerning to attack style of wrestling

with defensive wrestling style (Table 3). Current result indicates high level of visual analyzer efficiency among wrestlers with defensive style, in comparison to offensive athletes. Perhaps, this fact is related to the right hemisphere dominance among wrestlers with defensive style.

Considering the time limit indicator for processing information, there were differences found among different groups of athletes. However, there is a tendency of information processing time to increase among athletes with combined wrestling style, which indicates deceleration of high-speed neurodynamic characteristics.

Thus, the test of nervous processes functional mobility revealed presence of lability of nervous processes among wrestlers with defensive wrestling style. However, throughput capability indicator of visual analyzer has better values among wrestlers with defensive style of wrestling, which can be explained by functional brain hemispheres asymmetry with a dominance of the right hemisphere.

Discussion

Modern development of wrestling (Greco-Roman, Freestyle and Female) characterized by rules changes to make sport more spectacular and to increase intensity of wrestling bout [Tunnemann *et al.* 2016; Lopez-Gonzalez *et al.* 2013]. Wrestling matches are being activated by referee on the mat and passivity leads to sanctions. Moreover, there is a time limit for technical actions execution. Therefore, there is a need to demonstrate speed and strength qualities in a limited time frame [Tropin *et al.* 2013].

Change in the wrestling bout dynamics leads to necessity to activate those qualities of wrestler, which ensure fast excitation redistribution and deceleration of nervous processes [Korobeynikov *et al.* 2017]. Yet, respective feature is conditioned by neurodynamical characteristics, which are genetically determined.

Studies of several groups of researches showed, that individual brain asymmetry profile can be considered as a base for individual motor activity, and it regulates characteristics of movements management [Schwenkreis *et al.* 2007; Parmigiani *et al.* 20093; Tomasino *et al.* 2013].

Considering the fact, that functional brain asymmetry is also genetically determined, there is a need to research a connection between strategies of wrestling tactics and functional brain hemispheres asymmetry.

The analysis revealed, that there is a greater dependence on processing information form external stimuli among wrestlers with defensive wrestling style. At the same time, it was found, that defensive style of wrestling is consistent with prevalence of functional brain asymmetry, and dominance of right brain hemisphere. Among wrestlers with defensive style the following features were identified: high level of stress resistance and optimal lability of nervous processes

with deceleration of speed of perception and processing information.

Defensive style is characterized by relative field independence from external stimuli under conditions of perception and processing information.

At the same time, among athletes with offensive wrestling style presence of brain hemispheres symmetry was identified. However, the speed of excitation and deceleration processes are relatively slow among wrestlers with offensive style of wrestling, which indicates presence of stereotyped sports technique motor structure.

Combined wrestling style characterized by presence of the filed independence from external stimuli and symmetry of brain hemispheres. At the same time, this group demonstrates best qualities of perception and processing information. Athletes with combined wrestling style are characterized by high level of stress resistance and ability of nervous system to rapidly accelerate excitation and deceleration processes under conditional reflexes appearance. Revealed result is consistent with our previous studies related to relations between high level of stress resistance and nervous system dynamics among elite level athletes.

Our previous study showed that combat athletes who have high level of motivation to achieve success prefer the attack fight [Korobeynikov *et al.* 2011, 2017]. This study indicated the links between brain hemispheres symmetry with attack fight in elite wrestlers. We presume that this fact shows the impact functional brain asymmetry to motivational activity of elite athletes.

Conclusions

1. Interconnection between styles of wrestling among elite level wrestlers and characteristics of functional brain asymmetry was identified.
2. It was found that offensive style of wrestling among elite level wrestlers is related to presence of brain hemispheres symmetry, field independence from external stimuli, high stress resistance and high speed of perception and processing information.
3. Defensive style of wrestling among elite level wrestlers is characterized by functional brain asymmetry with a dominance of right hemisphere, filed dependence from external stimuli and high throughput neurodynamic processes capacity.
4. Combined style of wrestling among elite level athletes is characterized by functional brain symmetry and field independence from external stimuli. At the same time, combined style indicates lower level of stress resistance, in combination with emotional stability and optimal lability of nervous system.

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Taktyczne style walki i asymetria funkcjonalna mózgu wśród elity zapaśników

Słowa kluczowe: style taktyczne, walka, asymetria funkcjonalna mózgu, elitarni zapaśnicy

Abstrakt

Cel. Celem pracy było zbadanie zależności między funkcjonalną asymetrią mózgu a taktycznymi strategiami w czasie zawodów wśród zapaśników na najwyższym poziomie. Metody. Zbadano trzydziestu elitarnych sportowców (członkowie ukraińskiej reprezentacji narodowej w zapasach w stylu

klasycznym) w wieku 20-28 lat. W celu określenia dominacji półkuli mózgowej zastosowano test oceny zależności (wersja testowa *Color & Word Test* J.R. Stroop, 1935). Poziomą stabilność psychoemocjonalną (odporność na stres) i mobilności funkcjonalnej procesów nerwowych został określony zgodnie z wynikami kompleksu psycho- diagnostycznego *Multipsychometr-05*. Analiza statystyczna danych została przeprowadzona przy użyciu pakietu oprogramowania *Statistica 6* z wykorzystaniem metod statystyki nieparametrycznej. Wyniki. Stwierdzono, że ofensywny styl zapaśniczy wśród elitarnych zapaśników związany jest z obecnością symetrii półkul mózgowych ($p < 0,05$), terenową niezależnością od bodźców zewnętrznych ($p < 0,05$), wysoką odpornością na stres ($p < 0,05$) oraz dużą prędkością odbioru i przetwarzania informacji ($p < 0,05$). Defensywny styl walki, zaobserwowany u elitarnych zapaśników, związany jest z funkcjonalną asymetrią mózgu, z dominacją prawej półkuli ($p < 0,05$), zależnością od bodźców zewnętrznych i wysoką przepustowością procesów neurodynamicznych ($p < 0,05$). Łączony styl zapaśniczy, zaobserwowany u elitarnych zapaśników, związany jest z funkcjonalną symetrią mózgu i niezależnością terenową od bodźców zewnętrznych ($p < 0,05$). Jednocześnie styl łączony (kombinowany) wskazuje na niższy poziom odporności na stres ($p < 0,05$), w połączeniu ze stabilnością emocjonalną i optymalną wydolnością układu nerwowego ($p < 0,05$).

Wnioski. Zidentyfikowano powiązania między stylami walki wśród elity zapaśników a charakterystyką funkcjonalnej asymetrii mózgu.