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Relationships between postural stability in standing and handstand and psychological factors in athletes practicing artistic gymnastics

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background: The aim of this study was analyze relations between postural stability indices and selected psychological factors in athletes practicing artistic gymnastics.

Material and methods: The study included 20 athletes practicing artistic gymnastics. The research tool was posturograph CQ-Stab 2P. The data were analyzed based on Pearson's linear correlation, or alternatively Spearman's rank correlation.

Results: Statistically significant correlations of stability indicators registered in the handstand with the results of the Competitive State Anxiety Inventory - 2R CSAI questionnaire were found, in the absence of psychological variables with the results of stability tests in a free standing position with eyes open and without visual control.

Conclusions: On this basis, we concluded that the psychological factor does not fundamentally affect the control of stability in standing which is natural position for human, even without inspection of the surroundings. The increase in the level of physical and cognitive anxiety and the decrease in self-confidence indicates a relationship with the deterioration of stability in the handstand position. In turn, the general conviction of the contestant to deal with difficult situations and obstacles, as well as the type of motivational orientation do not have a direct impact on stability.

Key words: artistic gymnastics, postural control, psychological factors.

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INTRODUCTION

Artistic gymnastics is a discipline that, both during training and sport competition, puts very difficult and dangerous demands on the contestants. Fulfilling the basic training assumptions which concern the development of a model technique of gymnastic elements and then presenting them during sports competitions requires both appropriate physical and psychological preparation [1, 2].

Among the components of physical fitness, the ability to maintain balance in static positions and dynamic exercises which are performed on various gymnastic devices is of particular importance [3]. Proper control of the body's stability significantly contributes to the improvement of the contestants' safety during motor tasks [4].

The central nervous system is responsible for the stability of the body posture which processes information from the organs of sight, and the vestibular and somatosensory systems (proprioceptors and skin receptors) [5]. A review of the scientific literature devoted to these issues clearly shows that adequately planned training can be effective for postural and neuromuscular control improvements [6]. Enhancement of body stability occurs in the process of technical improvement, which is confirmed by studies in which younger contestants were compared to those with more advanced training experience [7, 8]. However, the influence of various psychological factors on maintaining the balance in the natural and non-natural positions performed in gymnastic training has not been sufficiently studied. In the search for links between postural stability and a sense of fear of falling, the focus was mainly on elderly people. It was noted that, for example, balance training reduces the fear of falling [9–12].

The effectiveness of improving sports technique and thus improving the stability of the body is closely related to the appropriate volitional preparation of a gymnast. Sport competition puts a lot of demands on athletes [13]. Naczk-Musiał and Tokarz [14] emphasized that the emotions accompanying athletes, especially those related to the start, coexist with anxiety having physiological, cognitive and behavioral symptoms. Pineda-Espejel et al. [15] described this anxiety as a negative emotional state associated with the stimulation of the organism, which is characterized by nervousness, bothering and fear. According to Martens et al. [16], subjective symptoms of anxiety should be considered in relation to cognitive, somatic components and a sense of self-confidence. Martens et al. [16] claim that the state of cognitive anxiety is caused by predicting a negative course of competition or a low level of confidence in oneself and one's own skills. The somatic element results directly from the activation of the body, and the symptoms include nervousness and tension. In turn, the lack of so-called self-confidence can directly affect the state of cognitive anxiety. McClelland [17] described the achievements motivation as a result of tension existing between conflicting tendencies: hope focused on success and fear of failure. People with high motivation of achievements are characterized by a tendency to focus on distant and specific goals and difficult tasks, but they are likely to be successful. According to Nicholls [18], factors motivating a contestant to participate in sport competition include task orientation when the goal is to increase the performance level of the task (task-orientation), own progress or ego orientation (ego-orientation), when the player considers defeating the rival as success, recognition and fame. Competitors, for whom task orientation is the motivating factor, focus on self-improvement and improvement of their own skills. Therefore, the training process is significant and satisfying for them.

The analysis of the available literature and own reflections prompted the authors to take up the subject of the study, the aim of which was to analyze relationships between postural stability indices and selected psychological factors in athletes practicing artistic gymnastics.

MATERIAL AND METHODS

PARTICIPANTS

The study included 20 senior athletes practicing artistic gymnastics in Polish gymnastic clubs (average age: $\bar{x}$=21.10±3.80 years). The mean training period of the tested athletes was $\bar{x}$ =15.25±3.60 years. Their mean body weight was $\bar{x}$=68.71±6.08 kg and the mean body height $\bar{x}$ =173.80±5.73 cm. Selection of the research groups was purposive. The inclusion criteria were: competitive artistic gymnastics for at least 10 years, no complaints resulting from injuries to the musculoskeletal system, the ability to keep handstand for 30 seconds, written informed consent to participate in the study. The study was approved by the Bioethics Committee at the Regional Medical Chamber in Krakow, Poland (Approval Ref. No. 42/KBL/OIL/2017).

POSTURAL STABILITY TESTING

Body balance tests were conducted in the morning, before the training. They were preceded by a 15-minute warm-up, after which each of the gymnasts performed two trials of handstand on a mattress. In order to preserve the integrity of the research process, all the tests were carried out using the same measuring instruments operated by the authors. The measurements were carried out in the gym, in conditions which ensure isolation of acoustic stimuli that could interfere with postural reflexes during the study. Athletes were wearing gymnastic costumes without shoes. All procedures were carried out in full compliance with the Declaration of Helsinki. All participants received detailed information concerning the aim and methodology used in the study.

The research tool was two-platform posturograph (CQ Electronic System). The test consisted of three 30-second trials. The first attempt was the measurement of the body stability in a relaxed standing position. The platforms were levelled, their surfaces aligned in a single plane. After entering the platform, the subject stood still trying to keep his eyes on the fixation point which was placed 1 meter away. The stance width of the lower limbs and the feet angle were natural, unforced. Subsequently, the second test was conducted, while the subject had his eyes closed (i.e. had no visual control over the positioning of his body). The third trial was carried out in handstand. Before measuring the body stability in this position, the plates of the platform were placed at a distance allowing the subject to have free hand spacing. The subjects performed handstand with rebound of one leg and swing of the other leg. Stability measurement was recorded when the lower limbs were joined in a vertical position. During the test, the examiner stood next to the examined person for protection.

The following indicators of stability were analyzed:

- SA – sway area delimited by the COP point, in mm^2;
- MV – mean velocity of COP displacements on both axes (X-Y), in mm/s,
- MVAP – mean velocity of COP displacements on the Y axis (anteroposterior direction: AP), in mm/s,
- MVML – mean velocity of COP displacements on the X axis (mediolateral direction: ML), in mm/s,

- MA – mean amplitude (radius) of COP displacements, in mm;
- MAAP – mean COP displacement from the origin on the Y axis, in mm;
- MAML – mean COP displacement from the origin on the X axis, in mm;
- MaxAP – maximal displacement of the COP from 0 point along the Y axis (anteroposterior stability range), in mm;
- MaxML – maximal displacement of the COP from 0 point along the X axis (mediolateral stability range), in mm;
- MF – mean frequency of COP displacements, in Hz.

Psychological factors testing

The study of variables was conducted one hour before the stabilometric tests, using the following research tools:

- Competitive State Anxiety Inventory – 2R; CSAI-2R [16, 19] in the Polish adaptation by Borek-Chudek [20]. We assessed: somatic fear caused by physiological changes experienced as an anxiety (e.g. increased heart rate, increased blood pressure, stomach cramps, fast breathing, facial flushing, sweating), cognitive anxiety (due to disturbing thoughts, doubts, images of failure and humiliation), self-confidence as a factor important in coping with stress.
- General Self-Efficacy Scale (GSES) in the Polish adaptation by Jurczyński [21] – to assess the general belief of a human being in dealing with difficult situations and obstacles.
- Task and Ego Orientation in Sport Questionnaire (TEOSQ) [22] to assess the differences in terms of the dominant motivational orientations in relation to the sports situation: concentration on the task or "ego".

Statistical analysis

The consistency of the values with the normal distribution was verified by means of the Shapiro-Wilk test. The analysis of the links between balance indices and psychological variables was made with linear Pearson’s correlation, or alternatively the Spearman’s rank correlation. The results were considered statistically significant if the probability level of the test was lower than the predetermined significance level $p < 0.05$. The IBM SPSS Statistics application (version 24) was used to process the test results.

Results

The mean stability indices reached increasingly higher values as the degree of difficulty of individual trials increased. They were definitely higher in the handstand than in the standing position (Table 1).

The mean point values of individual CSAI-2R subscales were in the middle of the range of the values possible to obtain in each subscale. The average of the overall index of self-efficacy obtained on the basis of GSES scale results reached a level slightly exceeding the mean score. Higher mean value of the "Task" scale than "Ego" suggests that the task oriented motivational orientation dominated among the respondents (Table 2).

The data in Tables 3-4 indicate that there are no statistically significant links between the stability indices registered in the trials in the standing position and that without visual control with the psychological factors of the examined competitors.

Table 1. Descriptive statistics of balance indices registered in a standing position with eyes open (EO), eyes closed (EC) and handstand (HAND)

Stability indicator	Standing position (EO)		Standing position (EC)		Handstand (HAND)	
	x̄ ±SD	Me	x̄ ±SD	Me	x̄ ±SD	Me
SA	149.95 ±118.87	111.50	229.40 ±165.64	186.00	2661.55 ±1159.18	2390.50
MV	7.33 ±1.46	6.60	10.65 ±3.84	9.60	50.61 ±11.76	49.05
MVAP	4.61 ±1.25	4.10	8.05 ±3.83	6.30	42.36 ±11.77	40.35
MVML	4.70 ±0.77	4.50	5.26 ±0.97	5.20	19.55 ±5.16	18.70
MA	2.06 ±1.27	1.60	2.50 ±1.20	2.25	6.82 ±2.01	7.00
MVAP	1.78 ±1.31	1.30	2.20 ±1.27	1.850	6.21 ±1.92	5.90
MAML	0.74 ±0.33	0.70	0.80 ±0.22	0.80	1.96 ±0.72	1.80
MaxAP	5.51 ±2.96	4.30	9.72 ±6.84	7.70	23.29 ±6.09	22.35
MaxML	2.89 ±1.38	2.30	3.42 ±1.19	3.50	10.32 ±5.00	9.25
MF	0.69 ±0.26	0.72	0.76 ±0.27	0.78	1.22 ±0.25	1.20

Abbreviations: EO, eyes open; EC, eyes closed; HAND, handstand; SA, sway area delimited by the COP point; MV, mean velocity of COP displacements on both axes (X-Y); MVAP, mean velocity of COP displacements on the Y axis; MVML, mean velocity of COP displacements on the X axis; MA, mean amplitude (radius) of COP displacements; MAAP, mean COP displacement from the origin on the Y axis; MAML, mean COP displacement from the origin on the X axis; MaxAP, maximal displacement of the COP from 0 point along the Y axis; MaxML, maximal displacement of the COP from 0 point along the X axis; MF, mean frequency of COP displacements; x̄, arithmetic mean; SD, standard deviation; Me, median

Table 2. Descriptive statistics of psychological variables

Psychological variable		x̄ ±SD	Me
CSAI-2R			
	Somatic anxiety	21.14 ±4.67	21.40
	Cognitive anxiety	22.60 ±5.51	24.00
	Self-confidence	25.60 ±3.87	26.00
GSES		30.90 ±4.36	30.00
	TEOSQ		
	Task	25.11 ±3.15	25.10
	Ego	15.09 ±3.50	15.50

Abbreviations: CSAI-2R, Competitive State Anxiety Inventory-2R; GSES, General Self-Efficacy Scale; TEOSQ, Task and Ego Orientation in Sport Questionnaire; x̄, arithmetic mean; SD, standard deviation; Me, median

Table. 3. Relationships between balance indices obtained in the trial with eyes open (EO) with psychological variables

Stability indicator		CSAI-2R			GSES	TEOSQ	
		Somatic anxiety	Cognitive anxiety	Self-confidence		Task	Ego
SA-EO	R	-0.28	-0.18	0.07	0.30	0.14	-0.30
	p	0.231	0.445	0.766	0.207	0.559	0.198
MV-EO	R	0.05	0.05	-0.02	0.17	0.09	-0.34
	p	0.851	0.852	0.946	0.464	0.705	0.137
MVAP-EO	R	0.03	-0.02	0.04	0.22	-0.05	0.02
	p	0.918	0.931	0.864	0.343	0.851	0.950
MVML-EO	R	0.20	0.29	-0.22	-0.03	0.13	-0.31
	p	0.391	0.208	0.357	0.912	0.588	0.186
MA-EO	R	-0.35	-0.24	0.13	0.33	0.17	-0.24
	p	0.128	0.318	0.591	0.160	0.482	0.319
MAAP-EO	R	-0.42	-0.34	0.22	0.25	0.25	-0.28
	p	0.066	0.142	0.357	0.294	0.298	0.235
MAML-EO	r	-0.25	-0.10	0.03	0.24	-0.03	-0.36
	p	0.293	0.677	0.903	0.314	0.900	0.122

Table. 3 – continued

Stability indicator		CSAI-2R			GSES	TEOSQ	
		Somatic anxiety	Cognitive anxiety	Self-confidence		Task	Ego
MaxAP-EO	R	-0.41	-0.43	0.22	0.41	0.24	0.06
	p	0.072	0.059	0.351	0.076	0.311	0.817
MaxML-EO	R	-0.03	-0.03	-0.35	0.19	0.00	-0.30
	p	0.888	0.891	0.130	0.436	0.996	0.203
MF-EO	r	0.42	0.30	-0.26	-0.33	-0.13	0.13
	p	0.067	0.193	0.268	0.158	0.581	0.581

Abbreviations: EO, eyes open; SA, sway area delimited by the COP point; MV, mean velocity of COP displacements on both axes (X-Y); MVAP, mean velocity of COP displacements on the Y axis; MVML, mean velocity of COP displacements on the X axis; MA, mean amplitude (radius) of COP displacements; MAAP, mean COP displacement from the origin on the Y axis; MAML, mean COP displacement from the origin on the X axis; MaxAP, maximal displacement of the COP from 0 point along the Y axis; MaxML, maximal displacement of the COP from 0 point along the X axis; MF, mean frequency of COP displacements; CSAI-2R, Competitive State Anxiety Inventory-2R; GSES, General Self-Efficacy Scale; TEOSQ, Task and Ego Orientation in Sport Questionnaire; r, the Pearson's correlation coefficient; R, the Spearman's correlation coefficient; p, probability value

Table. 4. Relationships between balance indices obtained in the trial, excluding visual control (EC) with psychological variables

Stability indicator		CSAI-2R			GSES	TEOSQ	
		Somatic anxiety	Cognitive anxiety	Self-confidence		Task	Ego
SA-EC	R	0.09	-0.15	-0.16	0.22	-0.10	0.33
	p	0.721	0.537	0.489	0.355	0.435	0.157
MV-EC	R	0.08	-0.11	-0.09	0.19	0.02	-0.28
	p	0.738	0.652	0.713	0.433	0.927	0.231
MVAP-EC	R	0.01	-0.20	-0.02	0.26	0.08	-0.28
	p	0.967	0.403	0.95	0.268	0.752	0.235
MVML-EC	R	0.39	0.20	-0.43	0.29	-0.03	-0.06
	p	0.086	0.387	0.057	0.213	0.913	0.787
MA-EC	r	0.16	-0.05	-0.14	0.32	0.33	-0.02
	p	0.509	0.848	0.566	0.169	0.163	0.922
MAAP-EC	r	0.13	-0.06	-0.10	0.30	0.33	0.02
	p	0.598	0.817	0.691	0.198	0.155	0.94
MAML-EC	r	0.28	0.16	-0.29	0.13	-0.07	-0.38
	p	0.233	0.496	0.214	0.573	0.786	0.097
MaxAP-EC	R	0.05	-0.09	-0.08	0.19	0.23	-0.23
	p	0.836	0.698	0.747	0.412	0.341	0.335
MaxML-EC	r	0.29	0.03	-0.31	0.05	0.17	-0.21
	p	0.211	0.915	0.181	0.844	0.486	0.369
MF-EC	r	0.18	0.18	-0.15	-0.17	-0.23	0.16
	p	0.459	0.449	0.517	0.469	0.320	0.513

Abbreviations: EO, eyes open; SA, sway area delimited by the COP point; MV, mean velocity of COP displacements on both axes (X-Y); MVAP, mean velocity of COP displacements on the Y axis; MVML, mean velocity of COP displacements on the X axis; MA, mean amplitude (radius) of COP displacements; MAAP, mean COP displacement from the origin on the Y axis; MAML, mean COP displacement from the origin on the X axis; MaxAP, maximal displacement of the COP from 0 point along the Y axis; MaxML, maximal displacement of the COP from 0 point along the X axis; MF, mean frequency of COP displacements; CSAI-2R, Competitive State Anxiety Inventory-2R; GSES, General Self-Efficacy Scale; TEOSQ, Task and Ego Orientation in Sport Questionnaire; r, the Pearson's correlation coefficient; R, the Spearman's correlation coefficient; p, probability value

Analysis of the results obtained in the handstand test showed a statistically significant positive relationship between the size of the sway area delimited by the COP point and cognitive anxiety ($r = 0.44$; $p = 0.049$). The mean velocity of COP displacements in the X and Y axes correlated positively with somatic anxiety (r = 0.61; p = 0.005) as well as cognitive anxiety (r = 0.61; p = 0.004), and negatively with self-confidence (r = -0.45; p = 0.047). In addition, the average rate of COP displacements in the anteroposterior direction was positively correlated with somatic (r = 0.54; p = 0.014) and cognitive anxiety (r = 0.56; p = 0.011). Also, the mean velocity of COP displacements in the mediolateral direction showed relationships with somatic (r = 0.45; p = 0.045) and cognitive anxiety (r = 0.43; p = 0.049). There was also a statistically significant, positive mean relationship of the mean COP displacement from the origin in the mediolateral direction with cognitive anxiety (r = 0.58; p = 0.008) and a negative correlation of the mean frequency of COP displacements with self-confidence (r = -0.45; p = 0.049).

There were no statistically significant relationships between stability indices and GSES and TEOSQ test results (Table 5).

Table 5. Relationships between balance indices obtained in the handstand (HAND) with psychological variables

Stability indicator		CSAI-2R			GSES	TEOSQ	
		Somatic anxiety	Cognitive anxiety	Self-confidence		Task	Ego
SA-HAND	r	0.33	0.44	-0.12	-0.16	-0.18	-0.26
	p	0.162	0.049*	0.623	0.507	0.455	0.269
MV-HAND	r	0.61	0.61	-0.45	0.11	-0.15	-0.08
	p	0.005*	0.004*	0.047*	0.656	0.520	0.744
MVAP-HAND	r	0.54	0.56	-0.41	0.23	-0.12	0.00
	p	0.014*	0.011*	0.070	0.335	0.619	0.991
MVML-HAND	r	0.45	0.43	-0.33	-0.40	-0.18	-0.24
	p	0.045*	0.049*	0.156	0.079	0.445	0.303
MA-HAND	r	0.27	0.34	0.06	-0.01	-0.15	-0.28
	p	0.252	0.145	0.790	0.953	0.522	0.238
MAAP-HAND	r	0.23	0.29	0.11	0.02	-0.13	-0.20
	p	0.341	0.216	0.642	0.939	0.582	0.388
MAML-HAND	R	0.37	0.58	-0.23	-0.14	-0.23	-0.05
	p	0.105	0.008*	0.335	0.569	0.324	0.849
MaxAP-HAND	r	0.09	0.29	0.15	-0.18	-0.16	0.02
	p	0.708	0.221	0.536	0.442	0.498	0.941
MaxML-HAND	R	0.24	0.35	-0.26	-0.20	-0.27	-0.18
	p	0.304	0.135	0.275	0.409	0.255	0.439
MF-HAND	r	0.19	0.14	-0.45	0.05	-0.01	0.22
	p	0.419	0.554	0.049*	0.844	0.952	0.351

Abbreviations: HAND - handstand; SA, sway area delimited by the COP point; MV, mean velocity of COP displacements on both axes (X-Y); MVAP, mean velocity of COP displacements on the Y axis; MVML, mean velocity of COP displacements on the X axis; MA, mean amplitude (radius) of COP displacements; MAAP, mean COP displacement from the origin on the Y axis; MAML, mean COP displacement from the origin on the X axis; MaxAP, maximal displacement of the COP from 0 point along the Y axis; MaxML, maximal displacement of the COP from 0 point along the X axis; MF, mean frequency of COP displacements; CSAI-2R, Competitive State Anxiety Inventory-2R; GSES, General Self-Efficacy Scale; TEOSQ, Task and Ego Orientation in Sport Questionnaire; r, the Pearson's correlation coefficient; R, the Spearman's correlation coefficient; p, probability value; *, p<0.05

DISCUSSION

Our research indicates that there are no links between stability indices recorded during stand tests and the results of psychological tests. On this basis, it can be concluded that the psychological factor does not significantly affect the control of stability in a human standing position, even in the absence visual control of of the environment. Lack of statistically significant connections can also be dictated by the adopted test procedure, which assumed stability measurements on a platform set on the ground. The review of the literature indicates that the values of stability indices in measurements performed in a free stand position on the force plate located above the ground on a hydraulic platform significantly differ from the indices recorded on the floor. Carpenter et al. [23] in the research on young and older adults assessed selected psychological features and stability in a standing position on platforms set at different heights. The obtained data allowed claiming that state anxiety and balance efficacy are related to specific changes in postural performance with increased balance challenge. Hauck et al. [24] came to similar conclusions based on the research of young adult women and men. The authors' goal was to investigate the effects of postural threat on performance of three clinical balance tests. It was considered that the correlation analyses revealed significant associations between psychological measures and postural control measures. Increased frequency and decreased amplitude of COP displacement were observed during quiet standing in conditions of "high" compared to "low" postural threat. In turn, Brown et al. [25] tested a hypothesis that fall anxiety would differentially influence the regulation of upright standing among younger and among older adults. Regardless of age, postural control was more conservative when fall anxiety increased; however, age did not affect how anxiety influenced the regulation of postural control. It seems that carrying out similar research, especially among novice gymnastics athletes, may provide new data that will have a significant impact in the sport training process.

In sports training, especially in the process of motor adaptation, actions are taken to develop competitors' mechanisms enabling effective control of the balance in the inverted position [26], which is necessary to achieve a high sports level in artistic gymnastics. This is evidenced by the results of Kochanowicz's et al. research [27], which included younger (11-12-year-old) and older (18-26-year-old) gymnasts. In both examined groups, the authors showed statistically significant relationships between maintaining balance on the hands and the result of sports competition. Depending on the sport's advancement, the contestants use slightly different ways (strategies) of balancing. The body configuration for the handstand requires specific postural control from four joints: wrists, elbows, shoulders, and hips [28, 29]. It was noticed that in the case of experienced athletes the "wrist strategy" plays a dominant role in the control strategy [30–32]. In addition, Kochanowicz et al. [33] observed that the different gymnastic apparatus led to specific muscle activation. This activation predominantly depended on hand support conditions, which alternated the primary wrist strategy of the handstand balance control, and in consequence, the activation of other muscles controlling balance. Hauck et al. [24], on the basis of the test results of women and men who performed an unusual task, namely one-leg stance, decided that state anxiety was significantly increased during one-leg stance compared to both maximal reach and quiet stance. The results of our studies indicate a significant influence of some psychological factors on the correctness of the performance of difficult tasks, unnatural for humans, such as the handstand. There were statistically significant correlations of stability indices recorded in the handstand with psychological variables. These data allow concluding that the size of the surface area defined by the COP increases with an increase in cognitive anxiety in the attempt to stand on the hands. Increasing the average speed of COP displacements in the X and Y axes coincides with an increase in the level of physical and cognitive anxiety as well as a decrease in self-confidence. Also the average COP velocity of the displacements in the anteroposterior and mediolateral direction increases as the somatic and cognitive anxiety increase. Higher values of COP velocity prove “restless” and rapid movements of the body, and thus less stability. The competitor is then more likely to fall, which is a direct cause of failure in sports competition. The obtained data also indicate that the mean of all COP displacements in the mediolateral direction raised as cognitive anxiety increased, and the frequency of corrective responses increased as self-confidence diminished. The lack of links between GSES and TEOSQ scale results with the results of stabilometric measurements indicates that the contestant’s general belief in coping with difficult situations and obstacles, as well as the type of motivational orientation, do not have a direct impact on stability. Perhaps this is a result of too easy test tasks in which stability was measured. It is worth noting that the competitors qualified for the tests met certain inclusion criteria. One of them was the ability to maintain the handstand position on the platform for 30 seconds, which indicates a very good control of the task by the respondents.

However, it can be assumed that participation in this research was an unusual situation for the contestants, which may have contributed to the increase in anxiety as well as the decrease in self-confidence. This, in turn, adversely translated into stability indicators in handstand. Perhaps pre-start stress also affected the deterioration of these indicators. Therefore, it can be concluded that already on the day preceding the participation in important sports competitions, there may be significant changes in the contestants’ behavior which contribute to a decrease in the correctness of the performance of gymnastic tasks.

The moments of social exposure and the pressure to get the best result are an integral part of a sports career, which is why competitors should be prepared not only technically and physically, but also mentally. Of particular importance are activities aimed at alleviating somatic anxiety (resulting from the activation of the body which cause nervousness or tension) and developing a sense of self-confidence that can directly affect the state of cognitive anxiety.

Summing up the results of own studies, it should be emphasized again that the learning process of gymnastic elements should be supported by appropriate psychological preparation, which is important from the point of view of safety and quality of exercise, especially in inverted positions. The results obtained are a contribution to further scientific research in order to review the observed trends more accurately. In order to achieve this goal, research on postural stability and its variability due to sports training should be continued. We express our conviction that every report regarding the issues raised in the study constitutes a valuable complement to the few publications on the subject. It would be beneficial to verify our results based on the study of links between the quality of performance of more difficult and more dangerous gymnastic elements with psychological variables.

CONCLUSIONS

The psychological factor does not fundamentally affect the control of stability in standing which is natural position for human, even without inspection of the surroundings. The increase in the level of physical and cognitive anxiety and the decrease in self-confidence indicate a relationship with the deterioration of stability in the handstand position. In turn, the contestant’s general conviction to deal with difficult situations and obstacles as well as the type of motivational orientation do not have a direct impact on stability.

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