PHYSIOLOGICAL CHARACTERISTICS IN SUCCESSFUL FEMALE SINGLE FIGURE SKATING ATHLETES

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Abstract: The actual problem, we are trying to reveal in our study, - the identification of physiological characteristics allowing, to carry out earlier allocation of successful in competitions figure skaters - singles. We are trying to reveal in our study is the identification of physiological characteristics, allowing to carry out, earlier allocation the successful in competitions figure skaters – singles. The results obtained can be used in sports selection for women's national figure skating teams. The results of the study will allow coaches to make a timely correction of the training process in figure skaters with low potential in the implementation of the content of motor programs in competitions. In order to fulfill the purpose of the experiment, physiological testing of 30 highly qualified female figure skaters: female figure skaters - single skaters, engaged in figure skating, with a sports experience of figure skating -11, 58 ± 0, 98 years was carried out. According to the success rate of performance in competitions, 2 groups of athletes were selected: gr1 (n=8) - figure skaters taking prize-winning places in competitions; gr2 (n=22) - figure skaters actively participating in competitions, but not taking prize-winning places. Modern research methods used to assess the functional state and physical qualities of figure skaters: psychophysiological testing performed by using the computer program "Explorer of spatial and temporal properties of the nervous system (Yu.V. Koryagina, S.V. Nopin (2003)), the mental performance of figure skaters judged by the results of the three-stage test "Mental performance" with increasing cognitive load (V.V. Son'kin (2009)). The results of physical performance of female athletes were judged by the results of the Kenneth Cooper test in the form of a smooth run performed in the standardized conditions of the university 's athletics arena. The state of cardiorespiratory system judged by tonometry and spirometry (electronic spirometer C - Spiro 100). Conclusions about the differences in vertical stability were made

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on the basis of computer stabilometry data when skaters performed a battery of tests: "Target", "Stability in Romberg pose", performed on 2 - x legs and separately on each leg tests "Stability in a specific stance "Roll out", performed by skaters separately on the right and left legs. The conclusions reflect the results of the obtained differences in the comparison groups, proved mathematically using in Microsoft Excel and IBM SPSS Statistics 25 programs. As a result, of physiological testing we have revealed significant differences in psychomotor and physical performance of figure skaters, emphasizing the greater ability of successful skaters to resist fatigue and develop more actively, when performing cognitive loads of increasing complexity. The results of the stabilometric test "Stability in a specific stance "Roll out", performed by skaters on the dominant, right leg with visual control, were found to be the most informative for differences in the comparison groups. All our skaters from the 1 gr were right-handed. It has been established, that figure skaters, who successfully perform in competitions, have better coordination abilities, which is determined by the active participation of subcortical structures and cerebellum in the maintenance of vertical posture. In the stabilometric test "Stability in a specific stance "Roll out"", performed by skaters on the dominant, supporting right leg with visual control, we found the maximum number of reliable differences in the indicators of skaters from gr1, compared to athletes gr2. That were noted: a shorter length of the trajectory along the sagital and low speed of the center of pressure movement when performing test tasks, which emphasizes the greater efficiency of postural control necessary to maintain an upright posture. Figure skaters, who are less successful in competitions, have worse coordination abilities, which is determined by the more active participation of higher regulatory systems (cortex and subcortex) in maintaining posture. The revealed differences can be useful for sports selection of single figure skaters in the national team of single figure skating and for the correction of the training process of single figure skaters.

Keywords: figure skating, single skating, functional state, psychophysiological testing, spatial orientation, time orientation, stabilometry, vertical stability, highly qualified athletes.

Relevance of scientific research

The actual problem that we are trying to reveal in our study is the identification of physiological characteristics, allowing to carry out earlier allocation of successful in competitions figure skaters – singles, realizing their potential in the form of quality performance of the content of motor programs, allowing to take high prizes in competitions in figure skating on horseback.

The high results of Russian athletes in women's single figure skating are well known and still unattainable. Since 2017, there has been a linear increase in results at the championships of Russia, Europe, the world, and the Olympic Games, which reflected in the increased difficulty of performing various motor programs by single skaters. Objectively, this is reflected by the sum of points for the performance of short and free programs for the leader of women's single figure skating in the Russian Federation: A. Petrosyan (1st place) in 2025 - 177.14 (b); A. Petrosyan (1st place) in 2024 - 167.74(b); S. Akatieva (1st place) in 2023 - 164.15(b). These data emphasize the increasing difficulty of athletes performing "twizzles", "combined rotations", jumps, and other elements. There is a strong strain on the functional systems of the athletes' bodies, which reflected in the judges' assessment of the content of motor programs. However, further growth of athletic achievements and an increase in the technical potential of figure skaters is impossible without the use of high-quality scientific support for the training process and the development of new criteria for the selection of promising athletes and sportswomen [6, 8]. When practicing figure skating, athletes' bodies affected by a whole range of extreme factors: low temperatures, the audience, and the stress of physical exertion at competitions, which places special demands on their adaptive capabilities [9]. Important criteria for assessing the prospects of figure skaters are indicators of physiological testing, reflecting the adaptive capabilities of figure skaters when performing specific work and allowing them to effectively determine significant selection criteria at the stage of high qualification.

The purpose of the study

To conduct a comparative analysis of the indicators of functional status, vertical stability and physical qualities of highly qualified female figure skaters and to determine the physiological markers of success of female athletes.

Research methodology and organization

The design of the study is a solution to an urgent problem for sports physiology – the identification of physiological markers that make it possible to identify female figure skaters who win prizes at competitions and successfully perform the content of motor programs at competitions. For this purpose, we have chosen modern methods of physiological testing using computer technology. All the methods of physiological testing used by us are modern and tested by the results presented in the dissertations, approved by the Higher Attestation Commission of Russia.

The criteria for inclusion in experimental groups: 1. the presence in a sports category from 1 adult category to a master of sports; 2. the experience of figure skating more, than 10 years; 3. the performances of figure skaters at the championships of Russia and International championships; 4. high sports ratings; 5. absence at the time of examination of acute viral diseases, Covid and exacerbations of chronic diseases; 6. absence of premenstrual and the first three days of the menstrual phases of the ovarian menstrual cycle at the time of the study.

Figure skaters, who were excluded from the study: 1. without significant athletic achievements; 2. with acute respiratory diseases detected at the time of examination, 3. with premenstrual syndrome and menstruation in the first 3 days of anatomical menstruation; 4. with complaints of poor health and meteosensitivity.

Physiological testing conducted with the participation of 30 highly qualified female athletes involved in figure skating and having high athletic achievements. The average age of the athletes was: 18, 82 ± 0,9 years, the average length of experience in figure skating was: 11, 59 ± 0, 98 years; the average training load was: 30,01±0,9 hours per week. There are 2 groups of comparison of figure skaters according to athletic performance and qualifications: group 1 (gr1) consisted of single skaters, masters of sports (MS), who won prizes at responsible competitions (n=8 female figure skaters) and group 2 (gr2) consisted of figure skaters, candidates for Masters of sports (CMC) (n=22 female figure skaters). The figure skaters have high sporting achievements: winners and prize-winners of the championships of the Russian Federation, Moscow and the Moscow region, Krasnodar Territory, Chuvashia, Bryansk region. The athletes' sports history collected according to a sociological survey conducted in face-to-face format. The questionnaire of the figure skaters included questions characterizing the sports history (age, experience in the chosen sport, the presence of injuries and chronic diseases, sports in addition to the main physical activity, the highest athletic achievements), the analysis of sports genetics, taking into account sports and the success of parents and grandparents in it. In addition, they studied the motivation to practice figure skating, the characteristics of individual tolerance and reactions of athletes to physical activity, recreational activities after training and competitions, conflict with

coaches and choreographers, and the incidence of acute respiratory viral infections over the past year. The athletes examined during the preparatory period of sports training.

The physiological testing included: 1. Assessment of the anthropometric status of female athletes, with measurements of standing body length (cm) and body weight (kg), body circumference (chest circumference at rest, when inhaling, exhaling and circumference of body circumferences: shoulder, forearm, shin, hip and waist and head); mass index Body mass index is calculated using the formula. 2. The assessment of the psychophysiological status of the figure skaters was carried out on a computer with the implementation of psychophysiological tests in the program "Researcher of human temporal and spatial properties version 2.1" [4] and the URA test – human mental performance [7]. 3. The strength abilities of the athletes were assessed according to wrist dynamometry performed in the initial state of a vertical stand with arms extended to the side and 3 physical loads: 1st squat 30 with maximum tempo; 2nd jumps 1.5 minutes with maximum tempo and straightened legs and 3rd static load - holding the angle for 1 minute; as well as with an in-depth sample of "Reproducing the accuracy of muscle efforts" performed using a DMER-120 wrist dynamometer manu-factured by Tulinovsky Instrument-Making Plant TVES Joint Stock Company; 4. Cardio-hemodynamic parameters determined using a BP A50 tonometer from Microlife. The indicators were measured using a Korotkov methods electronic semi-automatic blood pressure monitor in a sitting position. Heart rate and blood pressure were determined, then systolic volume (SV) (ml) was calculated using the Starr formula: $90.97 + 0.54 \times$ PD-$0.57 \times$ DBP - $0.61 \times$ B, where PD is pulse pressure, DBP is diastolic pressure, B is age; minute blood volume (IOC) (l/min) = CO × HR; pulse pressure (PD) = SAD - DBP; average dynamic pressure in mmHg (according to the formula of N. N. Savitsky, 1974): SGD = $0.5 \times$ PD + DBP, where PD is pulse pressure; DBP is diastolic pressure. The reserve capabilities of the figure skaters' cardiovascular system assessed based on the results of the Roufier test. 5. The measurement of the ventilation function of the lungs was performed on an electronic spirometer Spiro S-100, Altonika LLC, Moscow; 6. The differences in the vertical stability of the figure skaters judged according to the data of the stabilometric testing performed on the domestic device Stabilizer – 01-2, OKB RITM CJSC, Taganrog. We used the following stabilometric tests: the "Target" test with biofeedback, the "Stability in the Romberg pose" tests performed on 2 legs and separately on each leg with visual control and its limitation, and the "Stability of figure skaters in a specific stance" and "**ROLL-out**" on the supporting leg were performed. All tests performed with visual control and its limitation. 7. The skaters performed the Kenneth Cooper test in the form of a smooth run performed in the standardized conditions of the university's athletics arena. The aerobic endurance of the figure skaters judged by the results of the Kenneth Cooper test performed by the skaters in

the form of smooth running, conducted in standardized conditions of the athletics arena of the university. Before and after performing the Kenneth Cooper test, the temperature in the armpit monitored; the maximum arbitrary strength of the muscles of the right and left arms and the time of the individual minute and heart rate (Polar 610). Wingate test performed on a mechanical ergometer with hardware and software upgrade (Monark Peak Bike 894E).

The pulse calculated at the end of each load using a Polar H10 heart sensor. Additional data on aerobic endurance obtained based on the results of the Cooper running test. Performed for 12 minutes with an assessment of temperature and vegetative shifts before and after the test.

According to our previous research, the success of highly qualified athletes in competitions, when engaged in complex sports, has significant differences depending on the level of psycho-emotional stress. Therefore, in the presented study, we use the determination of the level of psycho-emotional stress of figure skaters with the identification of personal and reactive anxiety according to the tests of Janet Taylor, Spielberger-Khanin [2].

Mathematical processing of the obtained data was carried out in Microsoft Excel and IBM SPSS Statistics 25 programs. The nonparametric Mann-Whitney U-test used to calculate statistically significant indicators between independent samples. The non-parametric Wilcoxon T-test used to calculate statistically significant indicators between dependent samples (with orthostatic test and Romberg stabilographic test).

Figure skaters excluded from the experimental groups if they had premenstrual, menstrual, and ovulatory phases on the test day.

The physiological testing was conducted before the training of the figure skaters in the standardized conditions of the laboratory of "Medical and Biological support of sports teams" of the Scientific Research Institute of Sports and Sports Medicine of the Russian Academy of Sciences "GTSOLIFK" during the hours of physiological sympathicotonia from 10.40 to 12.10 at a room temperature of 21.0 ± 1.0 °C and an air humidity of 57%, in compliance with ethical medical and biological standards as set out in the Helsinki Declaration and the Directives of the European Community. Before the start of the physiological testing, the athletes signed an informed consent protocol for the study.

The results of the study and their discussion

As shown by the results, of a sociological study in gr1, the parents of female athletes had high sports qualifications (KMS and I adult category) and high athletic achievements, which was noted in both parents, moreover, the fathers of figure skaters from

gr1 were 100% engaged in playing sports: football and rugby, and in parallel cyclic sports that develop aerobic endurance: skiing and athletics, which are marked by high sporting achievements. In 60% (3 people) of gr1 figure skaters, injuries of the musculoskeletal system noted: sprains of the ankle ligaments and bruises. Scuffing of the ankle skin on skates noted in 100% of cases. In the gr2 group, traumatic lesions noted slightly more often than in the gr1 group and accounted for 70% of cases. In gr2, the severity of sports injuries increases and there are combinations of OCD injuries with CNS damage in 20% of cases (2 people) in the form of a concussion, which is absent in gr1. According to the nature of the traumatic lesion in gr2, the following were noted: concussion of the brain - 10% (1 person), fractures of the distal humerus - 10% (1 person) and sacrum - 10% (1 person), ankle sprain - 60% (6 people).

In comparison with less successful figure skaters from gr1, gr2 skaters showed lower values of reactive and personal anxiety in the Spielberger-Khanin and J. Taylor (p<0.05), which highlights the low level of psycho-emotional stress that allows successful figure skaters to manage mental stress in sports competitions.

When analyzing anthropometric data, a decrease in the size of the chest circumference at rest, chest circumference on inhalation and exhalation was noted in figure skaters from gr1 compared with athletes from gr2, which, we believe, is due to the athletes belonging to the asthenic type of constitution and thoracic body type. However, athletes of the first group show a priority for the development of pulmonary ventilation, which is demonstrated by the parameter "Inhalation capacity", due to an increase in its component of the reserve volume of inspiration (p<0.05). These features of the morphological status and respiratory reserves of gr1 skaters can be explained, on the one hand, by belonging to a certain type of constitution, and, on the other hand, by higher morphofunctional transformations that occur in the body of female athletes during the development of fitness, under the influence of specific physical exertion.

The figure skaters from gr1 showed more efficient work of the neuromuscular apparatus, which reflected in the values of the maximum voluntary strength of the muscles of the left hand after the athletes performed a static load. The data on sports history, anthropometry, anxiety levels, and chronotypological characteristics of female figure skaters with different athletic performance are shown in Table 1.

Table 1. The results of morphofunctional status data in sports history, anthropometry, anxiety levels, and chronotypological characteristics of female figure skaters.

Parameters	g1, n=8 Me (Q1; Q3)	g2, n=22 Me (Q1; Q3)	p-level
Age, years	19 (19; 20)	19 (18; 19)	–
Experience in figure skating, years	15 (14,5; 15,5)	13 (10; 14)	–
Body length, cm	169 (166,5; 170,5)	165 (163,8; 170,3)	–
Body weight, kg	53 (51,5; 56,5)	55 (52; 62,5)	–
Body mass index	19,7 (18,6; 20)	20,6 (19,3; 21,6)	–
Chest circumference at rest, cm	82 (80,5; 83,3)	85 (83; 92,3)	p≤0,08
Chest circumference on inspiration cm	87 (86,5; 88,8)	91,3 (89,4; 97,3)	p≤0,06
Chest circumference on exhalation cm	80 (79; 81)	82,5 (81,4; 88,5)	p≤0,07
J. Taylor, scores	14,5 (14,3; 14,8)	19 (15; 22)	p≤0,05
Reactive personality anxiety, Spielberger Khanin, scores	33 (32,5; 33,5)	43 (40; 44)	p≤0,05
Reactive personality anxiety, Spielberger's readjustment, scores	3,0 (3; 3)	5,3 (5;6)	p≤0,02
Chronotype in the Horn–Ostberg test, in points	37 (35,5; 38,5)	49 (45; 52)	p≤0,04
The maximum arbitrary strength of the muscles of the left hand after static loading, given Inhalation capacity, ml	33 (32; 34)	29,3 (26,9; 31,6)	p≤0,05
Inhalation capacity, ml	2756 (2732; 2781)	2537 (2338; 2584)	p≤0,05

According to the results of the Horn-Ostberg test, differences in chronotypological characteristics of the circadian biorhythm daily activity of female figure skaters were established. In 100% of cases, figure skaters from gr1 have a daily "Arrhythmic" chronotype, therefore, they are as active as possible during daytime hours, which corresponds to training hours. Athletes from gr2, on the contrary, demonstrate a delay in the work of the biological clock and in 100% of cases note the daily chronotype "owl" with activity at night, when training has already been completed (table1). These studies will be continued by us to clarify the severity of the manifestations of chronotypes of figure skaters.

The psychophysiological characteristics of single skaters in comparison of the results are presented in Table 2.

Table 2. Psychophysiological characteristics of female figure skaters with different athletic performance.

Parameters of psychophysiological testing	g1, n=8 Me (Q1; Q3)	g2, n=22 Me (Q1; Q3)	p-level
Light response (ms)	244,1 (239,2; 249,1)	257,4 (254; 289,2)	p≤0,05
Individual minute (s)	58,8 (58,6; 58,9)	60,9 (55,6; 64,6)	p≤0,05
Reproduction of a time interval filled with a light signal (error in %)	5,5 (4,5; 6,6)	12,3 (7,2; 19,9)	p≤0,05
Estimation of the length of the segments (error in %)	3,8 (2,5; 5,1)	8,2 (6,8; 12,6)	p≤0,02
Recognizing angles (error in %)	0,1 (0,05; 0,15)	0,7 (0,3; 2)	p≤0,05

According to the results obtained (Table 2), significant differences in the perception of space and time by figure skaters were revealed, where successful figure skaters from gr1 demonstrate the best abilities to perceive biologically significant stimuli. Informative tests to identify significant intergroup differences were: "Reaction to light", "Reproduction of a time interval filled with a light signal", "Recognition of angles" and "Estimation of the length of segments".

The results of successful single skaters in competitions reflect higher mobility properties of nervous processes in the central nervous system in comparison with the test standards, while the results of figure skaters from gr2 usually reflect the lower values of such standards, which emphasizes the high lability of nervous processes in figure skaters from gr1.

The assessment of the psychomotor performance of the figure skaters in the comparison groups was carried out according to the results of the 3-stage URA test with the solution of cognitive tasks of increasing complexity (V.V. Sonkin (2009)). The results of the study presented in Table 3.

Table 3. Characteristics of mental performance according to the results of the URA test in single figure skaters with different athletic performance.

Mental Performance test indicators	g1, n=8 Me (Q1; Q3)	g2, n=22 Me (Q1; Q3)	p-level
Stage 1 attempt 7 (number of errors)	0,5 (0,3; 0,8)	3 (1; 4,3)	p≤0,03
Stage 1 attempt 8 (number of errors)	4 (3,5; 4,5)	6,5 (5; 7,5)	p≤0,05
Stage 3 attempt 1 (number of errors)	2 (1; 3)	5 (4; 5,3)	p≤0,05
Stage 3 attempt 4 (number of errors)	1,5 (0,8; 2,3)	3,5 (3; 5,5)	p≤0,05

It was found that athletes from gr1 noted a better ability to resist the development of fatigue when performing cognitive tasks, which is confirmed by significant differences on the 7th and 8th attempts at the end of the 1st stage of the test. With the complication of cognitive tasks at the 3rd stage of the Mental Performance test, significant differences were revealed on the 1st and final attempts of the test, emphasizing the priority of developing the speed of reflex reactions in gr1 skaters with the development of working out and a more pronounced ability to resist fatigue compared to gr2 skaters (Table 3).

When evaluating the performance of stability testing, it is necessary to say the following. In the "Target" test, the only difference in the comparison groups of skaters was found in the comparison groups - the average spread (R, mm) ($p<0.04$). When performing the "Stability in the Romberg pose" test on 2 legs in the comparison groups, differences in the indicators were found: the average spread (R, mm) ($p<0.05$) and the coefficient "Quality of the equilibrium function" ($p<0.02$). Such differences in the comparison groups are present both when performing the "Stability in the Romberg pose" test with visual control and when it is limited.

One of the most informative tests for identifying intergroup differences and highlighting successful single skaters in competitions is the "Stability in a specific pose" test, namely the "ROLLOUT" stand on the supporting leg with visual control. In this test athletes' body is affected by complicated conditions of reducing the area of support and changing afferentation in the absence of visual control, control while maintaining vertical balance. This effect makes it possible to judge the stability of an athlete's posture through her ability to withstand external forces that disrupt balance (Table 4).

Table 4. The results of the single skaters performing the Stability in a specific Stance stability test.

Parameters	g1 Me (Q1; Q3)	g2 Me (Q1; Q3)	p-level
VISUAL CONTROL TEST RESULTS			
Spread over the frontal plane, mm	4,18 (3,84; 4,2)	4,98 (4,7; 5,49)	p≤0,02
Spread over the sagittal plane, mm	5,05 (5; 5,32)	6,76 (6,65; 8,68)	p≤0,02
Average spread, mm	5,94 (5,71; 5,99)	7,53 (7,19; 8,39)	p≤0,02
Average velocity of the pressure center movement, mm/sec	33,97 (30,55; 37,12)	46,14 (44,87; 47,16)	p≤0,04

The rate of change in the area of the statokinesigram, sq.mm/sec	74,7 (62,9; 74,9)	121,9 (108,8; 150,1)	p≤0,02
Area of the confidence ellipse, sq.mm	302,1 (271,3; 311,4)	513,9 (451,8; 628,3)	p≤0,02
Velocity index	21,49 (19,32; 23,71)	29,42 (28,72; 30,25)	p≤0,04
Length of the trajectory of the center of pressure along the sagittal plane, mm	389,9 (352,1; 452,9)	565,3 (539,9; 633,6)	p≤0,04
Average linear velocity, mm/sec	33,94 (30,54; 37,09)	46,14 (44,88; 47,17)	p≤0,04
The amplitude of linear velocity variation, mm/sec	22,04 (18,69; 24,12)	29,08 (26,29; 31,67)	p≤0,04
Average linear velocity along the frontal plane, mm/sec	23,5 (21,1; 24,8)	29,1 (28,5; 31,5)	p≤0,02
Average linear velocity in the sagittal plane, mm/sec	19,5 (17,7; 22,7)	28,4 (27,1; 31,8)	p≤0,04
Vectorogram power, mm2/s	33,34 (27,86; 39,44)	58,26 (54,36; 63,65)	p≤0,04
TEST RESULTS WITH LIMITED VISUAL CONTROL			
Spread over the frontal plane, mm	11,77 (10,86; 13,8)	7,82 (7,3; 9,49)	p≤0,04
Amplitude of variation of angular velocity, deg/sec	20,1 (18,6; 21,1)	25,4 (24,2; 29,9)	p≤0,02
Amplitude of the first peak in amplitude on the spectrum of the frontal, mm	10,2807 (9,1888; 14,2229)	6,5878 (5,5986; 6,906)	p≤0,02

The results presented in Table 5, when performing the test tasks in difficult conditions of limited surface area with visual control, revealed the obvious advantages of vertical stability of g1 skaters. An important indicator of the test characterizing the postural stability of figure skaters is the "Area of the confidence ellipse" indicator, lower values of which found in figure skaters from g1. Significant differences in the values of the indicators established: "Average spread" and "Spread along the frontal and sagittal planes", which emphasizes the lower deviation of the central nervous system along the corresponding planes and the better vertical stability of the g1 skaters.

Figure skaters, who take prizes at competitions note 2 times lower values of the indicator "Length of the trajectory of the center of pressure along the sagittal plane", in comparison with g2 athletes. Single figure skaters from g1 note lower values of the following indicators in comparison with athletes from g2: "Average velocity of movement of the pressure center", "Rate of change of the area of the statokinesigram", "Average linear velocity" and "Average linear velocity along the frontal and sagittal planes", which determines the high degree of involvement of regulatory systems in the

process maintaining an upright posture indicates their normal operation. The low values of the velocity of the center of pressure movement in the g1 skaters accompanied by significantly lower values of the "Amplitude of linear velocity variation" indicator, which emphasizes a lower displacement of the central nervous system to the sides and a more optimal state of bioelectric activity of the central link of the postural system.

When performing the test with a lack of visual control, both groups of athletes perform worse at completing the task. Figure skaters from g1 note lower values of the "Amplitude of angular velocity variation" indicator, which indicates a lower displacement of the central nervous system. However, the figure skaters from g2 note a lower value of the "Spread over the frontal plane" indicator.

Assessing the reserve capabilities of the cardiovascular system in figure skaters of varying competitive success, it should be noted that athletes from g1 have a pronounced effect of the parasympathetic nervous system at rest, which is consistent with moderate athletic bradycardia at rest. The results of the Roufier test indicate a greater functional range of CCC reserves in g1 skaters, who demonstrate "excellent" results on the test score scale (Table 5).

Table 5. Indicators of the cardiovascular system and aerobic endurance of female figure skaters with different athletic performance at rest and when performing dynamic tests.

Parameters	g1, n=8 Me (Q1; Q3)	g2, n=22 Me (Q1; Q3)	p-level
Heart rate at relative rest (beats/min)	62 (60; 64)	81 (68; 83)	p≤0,05
MAM (Wingate test) Average power (Wingate test)	13,91 (10,41; 13,99) 9,92(9,42; 10,83)	10,28 (6,7; 10,11) 8,11(6,01; 9,02)	p≤0,05
Cooper test, distance (m)	2500 (2450; 2550)	2114 (2008; 2120)	p≤0,05
The maximum arbitrary strength of the muscles of the right hand after the Cooper test (daN)	35,5 (35,3; 35,8)	32,5 (31,8; 34,3)	p≤0,05

The results obtained by us of differences in the reserve capabilities of the cardiovascular system among figure skaters of varying success correspond to the results of the Cooper test of a 12–minute smooth run by athletes. The best aerobic endurance observed in g1 skaters with a large increase in the maximum voluntary strength of the muscles of the right hand after performing the test (Table 5).

Discussion

We believe that our research has a certain scientific novelty, however, we note the connection between our results and the results of determining successful athletes with high athletic qualifications engaged in complex sports. In particular, from 2018 to the present, we have developed physiological criteria that distinguish dancers (both men and women), and gymnasts with high athletic performance in competitions, engaged in rhythmic gymnastics. The coincidence noted by the results of psychomotor and physical performance. However, we did not consider the battery of stabilometric tests, highlighting significant coordination abilities in terms of identifying differences. We have not previously considered the stabilometric tests performed with a pronounced limitation of the support area, performed by athletes in specific poses. Namely, these tests are of maximum importance in identifying the development of coordination abilities in highly qualified female figure skaters.

Based on the results of physiological testing, differences in physiological indicators established in the comparison groups of figure skaters with different competitive success. The results of psychophysiological testing revealed significant differences in the speed and accuracy of response to biologically significant stimuli (light). It should be noted, that successful figure skaters in the competition demonstrate high results of these reactions, which significantly exceeds the developed test standards. Figure skaters from gr2 always mark the lower limit of the standards of reactions to biologically significant stimuli, but do not exceed it. When assessing the perception of time in the "Time of an individual minute" test, it should be noted that the results in both comparison groups comply with the test standards. The gr1 skaters showed high values of the "Inhalation capacity" indicator, which may explain the high values of aerobic endurance according to the Cooper test. Tests for assessing vertical stability performed on a stability analyzer are informative criteria for selecting successful figure skaters who take prizes at competitions. Among the battery of tests we conducted, which included the following tests: "Target", "Stability in the Romberg pose" performed on 2 legs and separately on each leg with visual control and its limitation, the most significant for identifying intergroup differences is the test "Stability in a specific stance - "ROLLOUT", performed with visual control and its limitation. We recommend using the differences in the functional state, vertical stability, and physical qualities of figure skaters that we have established for the sports selection of female figure skaters for the national teams of the Russian Federation and the national teams of doubles. Among all the tests performed on the stabilizer are the datum V(mm) and EllS, (sq.mm) indices are of great importance in terms of revealing reliable differences. The differences in V(mm) and EllS, (sq.mm) emphasize the greater tension of the regulatory

systems in the regulation of vertical posture in figure skaters of group 2, when they performing the tasks of the tests.

In addition, it should be noted that significant differences in the levels of personal and situational anxiety (Janet Taylor and Spielberger-Khanin tests) among skaters with different competitive success rates emphasize the low level of psychoemotional stress among gr1 skaters. The revealed data indicates great opportunities for managing mental stress in sports competitions and allow athletes to develop the mobilization of regulatory, autonomic and muscular systems [1]. The results of the study are consistent with our data obtained earlier, when examining dancers of the SVK engaged in sports ballroom dancing [2,3].

Our recommendations for improving the training process for highly qualified female figure skaters consist primarily of recommending systematic monitoring of stability testing performed during the "Vertical Stability" test, performed in a specific "Roll-out" stance on the leading leg, with visual control.

This test allows you to be well-oriented in the level of development of the coordination abilities of female figure skaters. Undoubtedly, psychophysiological tests with serial effects on the sensory systems of female athletes are highly informative for identifying successful single skaters.

Tests such as "Mental performance" with 3 stages of increasing cognitive load[7], a simple sensory – motor reaction allow us to judge the orientation of athletes in space and time and reveal the dynamics of changes in the functional state of athletes during the development and ability of sensory systems to resist fatigue.

Some authors (Losnegard T. (2019) highlight the great contribution of the energy system to the development of a high range of functional status in promising athletes engaged in cyclic loads, which has yet to be studied in highly qualified figure skaters[5].

The results of the presented scientific work fully reveal the purpose of the study and will be continued by us in all areas carried out: psychophysiology, the study of physical performance, vertical stability and the conditions of energy system.

Conclusions

1. It has been established that the indicators of psychophysiological tests with serial stimuli (mental performance, simple visual-motor reaction), the stabilometric test "Stability in a specific stand–out", with visual control and its limitation, have the greatest informative value for identifying elite highly qualified figure skaters who are successful in competitions; among the respiratory volumes and capacities - the index of

inspiratory capacity, the indicator of the maximum voluntary strength of the muscles of the left hand after static loading and the level of personal anxiety in the J. Taylor test.

2. Elite highly qualified figure skaters who are successful in competitions have an average level of personal and reactive anxiety in the J. Taylor and Spielberger-Khanin tests, as well as belonging to the arrhythmic version of the chronotype in the Horn–Ostberg test, which, in our opinion, allows them to be more active during training hours and resist the development of competitive stress.

3. According to the results of stability testing, among the tests characterizing vertical stability, the test "Stability in a specific stand – "ROLL-out", with visual control and its limitation, which allows to identify more informative criteria of differences and a high degree of their reliability, has the greatest informative value for elite highly qualified figure skaters who are successful in competitions.

4. Skaters less successful at competitions have higher values of stabilometric testing in indicators V(mm) and EllS, (sq.mm) in the tests "Target" and "Stability in Romberg pose", performed on 2 - x legs with visual control, which emphasizes the greater tension of regulatory systems in the regulation of vertical posture of skaters from gr 2 in comparison with athletes from gr 1, when performing the tasks of the tests.

5. The data on the psychophysiological characteristics of elite highly qualified figure skaters who are successful in competitions reflect the high speed of development of working out, high-quality performance of the main part of the test task and slowing down the development of fatigue under the influence of a series of cognitive tasks of increasing complexity.

6. Figure skaters who are engaged in women's single figure skating, who are successful in performing various motor programs at competitions, according to pedagogical observation and sports history, have greater motor accuracy when performing mandatory elements, performing twizzles, jumps and step paths, which they perform efficiently and note a lower severity of sports injuries, which gives them the opportunity to faster to recover.

Conflict of interest

The author hereby declares that this research is free from conflicts of interest with any party.

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