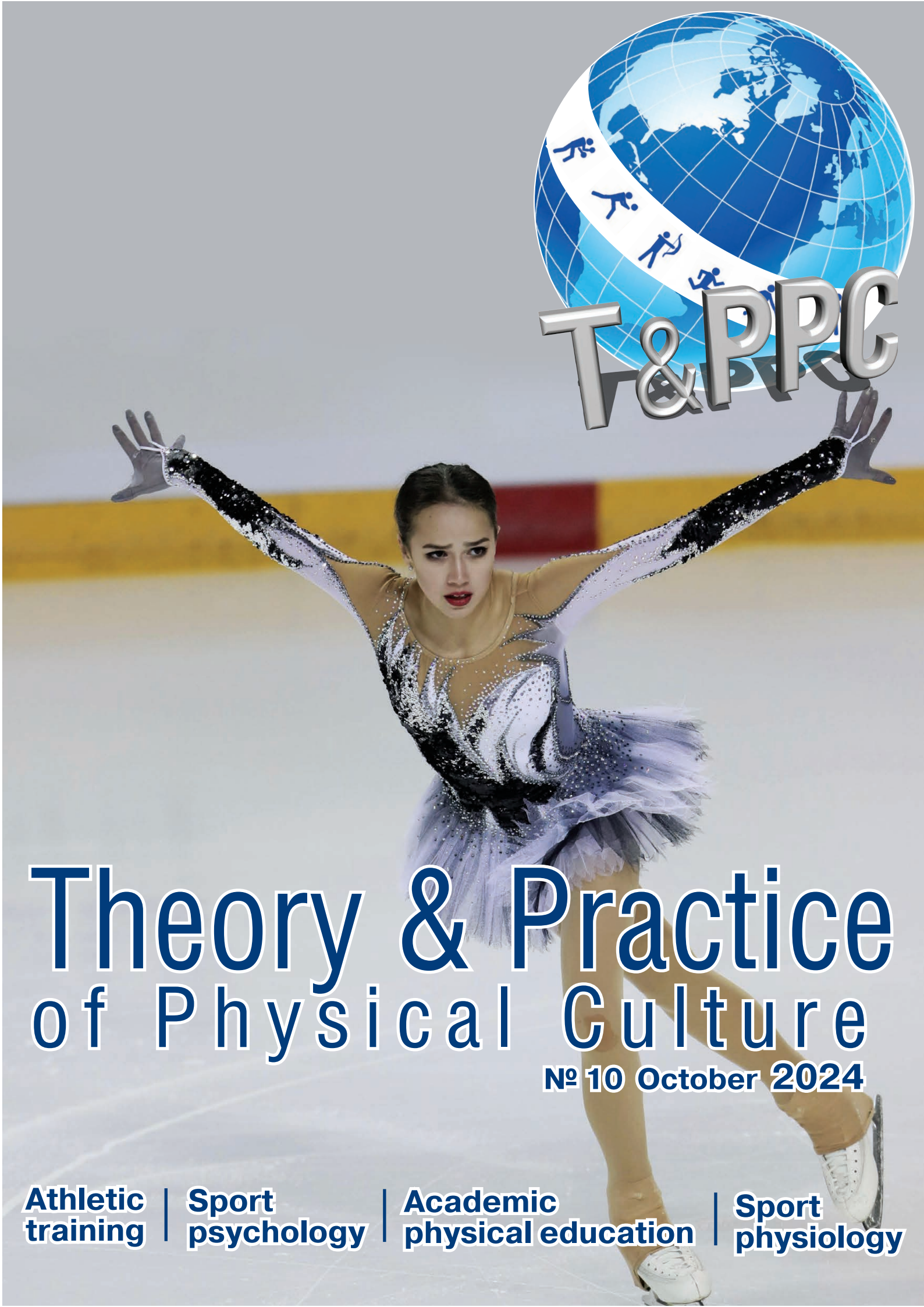


Theory & Practice of Physical Culture

№ 10 October 2024

Athletic training | Sport psychology | Academic physical education | Sport physiology

The phenomenon of sport in the context of equality and inequality in modern society

Today, sport can be represented as a two-dimensional coordinate system that reflects the level of accessibility and opportunities (equality and inequality) for each individual to participate in sports activities.

Despite progressive development, discrimination in sport still remains relevant and is expressed in various forms.

In women's sport, this problem is now taking on new features associated with the desire for equality, which is expressed in the expansion of the program and the inclusion of purely male types, such as boxing, weightlifting, football, hockey, wrestling and martial arts. The current situation leads to unjustifiably high physical exertion, a violation of the aesthetic perception and ethical behavior of athletes. Another side of this process, which reinforces gender inequality, is the admission of transgender people, usually men who have legally changed their biological sex, to competitions of the highest rank, including the Olympic Games. At present, a reverse trend is also emerging - expanding opportunities for men to participate in traditionally female sports: rhythmic gymnastics, aesthetic gymnastics, artistic swimming.

Women continue to experience social restrictions, expressed in a small prize fund compared to men, low attention and popularization of certain women's sports (for example, football, hockey) and, accordingly, smaller investments in their development.

Today, racial equality in sports is declared everywhere in the world. However, the economic conditions of development of some countries, for example, in Latin America, Africa, Asia, do not allow creating equal opportunities for the preparation and participation of athletes in international competitions. This inequality affects the reduction of prospects for achieving high sports results and victories. This is especially pronounced in elite sports, such as golf, tennis, yachting, etc. At the same time, equality is achieved in competitions in sports that do not require large financial outlays, for example, in long-distance and short-distance track and field, where African athletes have been consistently performing and occupying leading positions for many years.

Economic inequality arises not only in the racial aspect, but also in access to classes in youth sports. Due to the low level of financial security, many parents do not have the opportunity to choose the desired sport for their child. Modern youth sports require significant financial investments from parents both in the system of training a young athlete and for his systematic participation in competitive activities. At the same time, many do not realize that investments in the development of a child have a delayed effect. Upon achieving a high professional status, the financial capabilities of athletes are equalized and the financial costs of parents can be justified by subsequent high fees, sponsorship investments, investments in the development of a talented athlete. This trend explains the desire of parents to bring their child to a sports section, despite the high material costs. When discussing equality and inequality in sports, one cannot ignore the manifestation of sports genetics, when one athlete has sports talent and easily becomes a winner, while a less talented athlete remains an outsider despite high training loads. However, sports talent does not guarantee long-term success, and at some point a hard-working athlete becomes a winner. Thus, it can be stated that sports ensure equality of genetic, hereditary and social factors.

The uneven distribution of global resources and opportunities between countries gives rise to geopolitical inequality in sports, when strong and economically independent states occupy leading positions in international sports organizations and federations, and also dictate favorable conditions and rules for holding competitions.

The geopolitical factor also influences the promotion of sports that are financially beneficial for the political and sports elite. An example is tennis, where the participation of athletes is not limited by the requirements imposed on their colleagues representing other sports. In particular, political sanctions did not affect Russian tennis players, who were able to successfully perform at the 2024 Olympic Games in Paris, thereby achieving geopolitical equality in sports.

Considering sports in a coordinate system, it should be noted that the higher the inequality, the more pronounced the desire of the sports community for equality. Along with the growth of unequal opportunities based on gender, racial discrimination, differences in income and accessibility of infrastructure, the range of sports is expanding, opening up vertical and horizontal social mobility of athletes.

To contain negative factors and deviations in the behavior of athletes and sports managers, it is necessary to maintain the traditions of harmonization of social relations, smoothing out the interpolar differentiation of the sports space.

We invite scientists to publish the results of scientific research aimed at finding and studying the value meanings of physical culture and sports.

Editor-in-Chief of TPPC, Honored Worker of Physical Culture of the Russian Federation
Dr. Hab., Professor L.I. Lubysheva

Theory and Practice of Physical Culture

10'2024

Monthly Scientific-theoretical Journal, founded in 2013

ISSN 2409-4234

©ANO SPC «Theory and Practice of Physical Culture and Sport»

105122 Moscow,
Sirenevy blvd, 4.
e-mail: fizkult@teoriya.ru

http://www.tpfk.ru

Theory and Practice of Physical Culture

Contents

Essentials for mutual symmetrical and asymmetrical positions of wrestlers

UDC 796.015.134

PhD, Associate Professor **N.A. Fedyaev**[1]
Dr. Hab., Professor **E.V. Makarova**[2]
PhD, Associate Professor **A.N. Melentyev**[1]
N.G. Tsagolova[2]
[1]Russian Timiryazev State Agrarian University, Moscow
[2]Moscow Polytechnic University, Moscow

Corresponding author: kolyajud@mail.ru

Received by the editorial office on 04.07.2024

Abstract

Objective of the study was to reveal the differences in symmetrical mutual positions as a method of defense and asymmetrical positions as the method of attack. Besides this, the authors analysed the efficiency of the metod in fighting conditions.

Methods and structure of the study. At the purposes of the study video recording and shorthand recording of techniques with different mutual positions of wrestlers had been used. To indicate and measure the reaction forces of the support of wrestlers, the computer complex «AMTI» was used, as well as two dynamometric platforms. The platforms allow measuring the vertical and two horizontal components of the reaction forces of the support.

Results and conclusions. Mirror and identical (symmetrical) and asymmetrical mutual arrangements of wrestlers' body parts relative to the vertical axis during mutual grips were determined. The values of support reaction force (SRF) indicators were determined during symmetrical mutual arrangement of wrestlers and during a bending throw. Thus, during symmetrical mutual arrangements, the SRF indicators were 723,9 N, and during a bending throw – 3317,8 N. Methods for maintaining symmetrical mutual arrangements during defense and their violation during the execution of techniques were tested.

Keywords: *: attack, defence, wrestling, mutual position of wrestlers, symmetry, asymmetry, technical actions.*

Introduction. In the sports training of wrestlers, in the section on basic technical training, specialists distinguish and offer for mastering various positions (wrestler's stance (low, high, middle, right, left). The wrestler's stance is interconnected with the grip used and the technique of the techniques. In the mutual positions of wrestlers in mutual grips, we took into account the principle of symmetry. Symmetry is a concept associated with harmony (ordering of diversity) and proportionality of forms. It is usually believed that an event (object) has symmetry if it remains unchanged as a result of one or another operation performed on it.

The concept of symmetry is widely known and plays a significant role in everyday life. Symmetry is the invariance (constancy) of the laws of biomechanics with respect to any changes in the shape of the trajectory of movement. The following types of symmetry are distinguished: mirror, geometric, dynamic.

Mirror symmetry. The human body has (approximately) mirror symmetry relative to the vertical axis. Many architectural structures have mirror symmetry.

Geometric symmetry is associated with the conservation of energy (some quantities are conserved in time (athlete's capabilities, actions, execution time, efforts). This does not mean that the athlete cannot change or alter his actions, but any change that occurs with the subject must be such that the named quantities remain proportionate.

Dynamic symmetry. It includes calibration, that is, a change in scale, respectively, of the athlete's capabilities, his actions, level of effort, execution time of the action.

The mutual arrangement of wrestlers in mutual grips has the following patterns: in symmetrical (mirror and identical) mutual positions, techniques are not performed. Techniques are performed in asymmetrical mutual positions. In other words, in order to per-

form a technique, it is necessary to break the symmetry relative to the vertical axis and break the balance of the support reaction forces in the «wrestler + opponent» system.

Objective of the study was to reveal the differences in symmetrical mutual positions as a method of defense and asymmetrical positions as the method of attack. Besides this, the authors analysed the efficiency of the metod in fighting conditions.

Methods and structure of the study. The hardware and software complex «AMTI» was used. To measure the support reaction forces (SRF) with different mutual positions of wrestlers in mutual grips, two dynamometric platforms of the AMTI company (USA) were used. The platform dimensions are 60×60×8 cm. The platforms allow measuring the vertical and two horizontal components of the support reaction forces. The natural frequency of the platform oscillations is 1000 Hz. The signals from the amplifiers were fed to the ADC input («L-Card», E-440) and then through the USB port to a personal computer. The software «ACTest» was used to collect and process the data.

Results of the study and discussion. A classification of the mutual positions of wrestlers in mutual grips is presented (Figure 1).

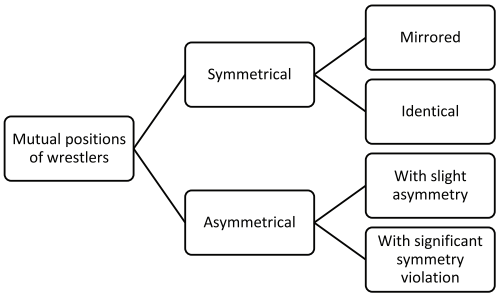


Figure 1. Classification of mutual positions of wrestlers in mutual grips

When analyzing the video recordings, not a single technique was recorded with symmetrical mutual positions of the wrestlers. The test wrestlers mastered a new method of defense by position, that is, they assumed the same position as the opponent.

Figure 3 shows the values of the support reaction forces (SRF) with symmetrical mutual positions of wrestlers in mutual grips. As can be seen from the dynamics of the SRF indicators, the convexity of the curve belonging to one wrestler is balanced by the convexity of the curve of the other wrestler.

A different picture is observed in figure 4. When performing a throw with a bend, the wrestler performing the technique has the highest values of the support reaction force, compared to similar indicators recorded for his opponent.

Table 1 and figure 2 present the indicators of the values of the support reaction forces of the wrestler with a symmetrical mutual position with the opponent and when performing a throw with a bend. When performing a throw with a bend, the support reaction force is 4,6 times higher than with a symmetrical mutual position.

Table 1. Indicators of the magnitude of the reaction forces of the wrestler's support in a symmetrical mutual position with the opponent and when performing a throw with a bend

Content	Support reaction force indicators (in newtons – H=kg*m/s²)
Symmetrical mutual positions	723,9
Carrying out a throw by bending	3317,8

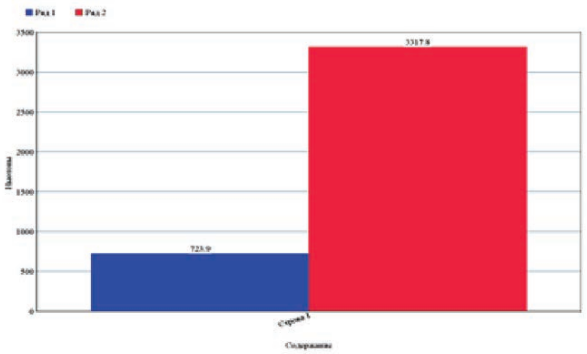


Figure 2. Indicators of the support reaction force of a wrestler in symmetrical mutual positions (row 1) and when performing a throw with a bend (row 2) (in Newtons)

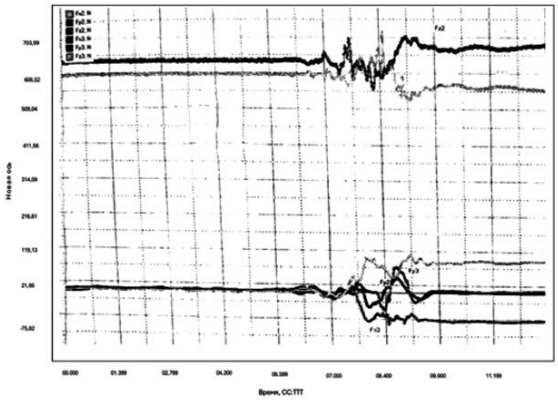


Figure 3. Indicators of the magnitude of the support reaction force (in Newtons) for symmetrical mutual positions of the wrestlers

Conclusions. Mirror and identical (symmetrical) and asymmetrical mutual arrangements of wrestlers' body parts relative to the vertical axis during mutual grips were determined. The values of support reaction force (SRF) indicators were determined during sym-

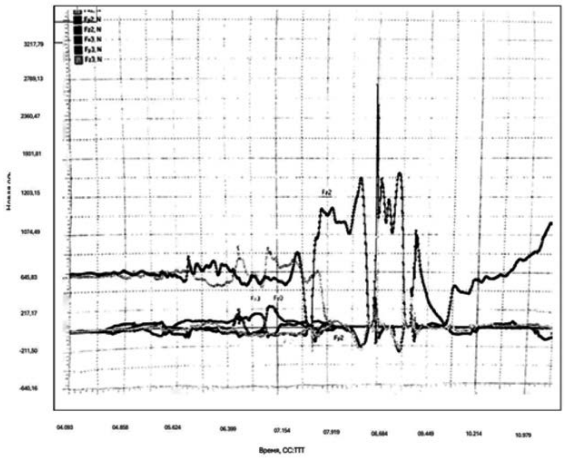


Figure 4. Indicators of the values of the support reaction force (in Newtons) when performing a deflection throw

metrical mutual arrangement of wrestlers and during a bending throw. Thus, during symmetrical mutual arrangements, the SRF indicators were 723,9 H, and during a bending throw – 3317,8 H. Methods for maintaining symmetrical mutual arrangements during defense and their violation during the execution of techniques were tested.

References

1. Fedyaev N.A., Nikitchenko S.Yu., Melentiev A.N., Musaev I.S.Kh. Vliyaniye morfologicheskikh osobennostey na tekhnicheskiy arsenal bortsov-sambistov. Teoriya i praktika fizicheskoy kultury. 2022. No. 12. pp. 15-18.
2. Shulika Yu.A. Greko-rimskaya borba dlya nachinayushchikh. Rostov-on-Don: Feniks publ., 2006. 238 p.
3. Sylka S.I., Irkhina I.V., Voronkov A.V., Shcherbin D.V. Intensifikatsiya obucheniya tekhnike sorevnovatelnykh uprazhneniy s giryami studentov vuzov fizkulturno-pedagogicheskogo profilya. Teoriya i praktika fizicheskoy kultury. 2023. No. 3. pp. 42-44.
4. Fedyaev N.A. et al. Individualnyye podkhody k izmeneniyu atakuyushchikh deystviy v partere v borbe dzyudo. Teoriya i praktika fizicheskoy kultury. 2021. No. 9. pp. 87-89.
5. Fedyaev N.A. et al. Osobennosti tekhniko-takticheskoy i koordinatsionnoy podgotovlennosti dzyudoistov razlichnykh vesovykh kategoriy. Teoriya i praktika fizicheskoy kultury. 2023. No. 10. pp. 95-97.
6. Tumanyan G.S. Shkola masterstva bortsov, dzyudoistov i sambistov. Study guide for students of higher educational institutions. Moscow: Academia publ., 2006. 591 p.

Dynamics of biomechanical indicators for 800-meter running technique in terms of competition for high-class athletes

UDC 796.422.14

PhD **A.B. Rafalovich**[1, 2]
A.L. Drozdov[2]
T.D. Atkishkina[2]
A.M. Podtochilin[2]
[1]The Federal Training Sports Center of the representative teams of Russia, Moscow
[2]Moscow State Academy of Physical Education, Malakhovka, Moscow Region

Corresponding author: niit2024@mail.ru

Received by the editorial office on 14.07.2024

Abstract

Objective of the study was to inquire the changes in biomechanical indicators of 800 m running technique in terms of competition for high-class athletes.

Methods and structure of the study. The analysis of changes in biomechanical indicators of 800 m running technique of highly qualified athletes at competitions were carried out. Based on high-speed video (250 fps) on straight sections of the track at four points of the distance, the characteristics of running technique (duration of phases, length and speed of running steps) of 19 participants were evaluated.

Results and conclusions. Reliably significant ($p<0,05$) changes from start to finish were revealed: a) increase in the duration of the push-off and support phases, b) decrease in the flight phase. The length and speed of the double step significantly ($p<0,05$) decrease from the middle of the distance to the finish. At the hypothesis level, it was noted that the decrease in the flight phase is largely associated with increasing fatigue, rather than with a change in running speed. A tendency towards increasing asymmetry of the running step along the distance was revealed.

Keywords: *high-class athletes, track and field athletics, middle distance runners, running technique, high-speed video, documents analysis.*

Introduction. In modern literature, much attention is paid to improving the efficiency of running technique, in particular, middle-distance running [1]. Oxygen consumption at a fixed submaximal speed, the amount of mechanical work performed by an athlete during running, the reaction of the cardiorespiratory system under load, as well as biomechanical characteristics of running technique: athlete's vertical body movement (AVBM) [3-6, 8], running stride parameters [7] are used as efficiency indicators. Analysis of the biomechanical characteristics of running technique is carried out using 3D shooting, tensometry, accelerometry and other technologies [2, 10]. Most of the listed technologies are used to study running technique in laboratory conditions during a specially organized study, less often in the training process. The amount of data on running technique, in particular, on running stride parameters, obtained during competitions is limited. At the 2017-2018 World Championships, 3D filming of the races was conducted, based on which biomechanical reports were published, including the parameters of the running stride over short distances [9]. An urgent task for finding means and methods for improving the training process of highly qualified middle-distance runners is to assess changes in the biomechanical characteristics of running technique from start to finish in competition conditions. Obtaining such data can be used to develop a methodology for assessing running technique using high-speed video filming.

Objective of the study was to inquire the changes in biomechanical indicators of 800 m running technique in terms of competition for high-class athletes.

Methods and structure of the study. *The study was conducted as part of the work on the NMO of the sports teams of the Russian Federation.* The studies were conducted on highly qualified runners, including athletes of the Russian national team. To determine the characteristics of the running stride of middle-distance runners, filming of men's 800 m races was conducted. The characteristics were calculated for 19 participants who showed results in the range from

1:47.63 to 1:54.00 min. Filming was carried out at the international competitions «Memorial of the Znamensky Brothers» (Moscow, Luzhniki Stadium, Northern Sports Center) in 2024. High-speed video cameras (250 fps) were placed opposite the running track so that the optical axes of the lenses were perpendicular to the marking lines. The races were filmed on straight sections of the running track at points along the distance located at 180, 380, 580 and 780 m from the start (filming points 1, 2, 3 and 4, respectively). The video materials were marked and digitized by one qualified operator. MaxTraq 2D software was used for processing. Track and field hurdles placed on each running track were used as scaling objects.

The durations of the phases, the length and speed of the double running step were calculated. At each of the four filming points, the durations of the support and unsupported (flight) phases were determined, as well as the smaller phases that make up the support phase: cushioning, push-off and the phase of switching between them. The durations of the phases were determined as the average value of the duration of each phase for two consecutive steps. The length of the double step was determined from the lift-off of the leg to the next lift-off of this leg from the track. When calculating the lengths, the distance between the corresponding points was found using the flat coordinates of these points. The length and speed of a double running step were calculated for the second (380 m) and fourth (780 m) points, for which the shooting scene was scaled using barriers.

A statistical analysis of the calculated indicators was performed using Statistica 64 software. To identify the reliability of differences in the average values of the studied indicators at the shooting points, Student's t-test for dependent samples was used.

Results of the study and discussion. The results are presented in Tables 1, 2 and figure 1. Each column of Table 1 contains the parameters of one of the compared pairs of survey points. 1. M.±σ in the rows of Tables 1, 2 is the mean value (s) and standard deviation at the first point from the compared pair, 2. M.±σ is the same for the second point. Traditionally, the phase structure of a running step is divided into support and flight phases. The use of high-speed photography made it possible to determine and calculate the duration of shorter phases on the support (Table 1). After the foot touches the support (in the amortiza-

Table 1. Comparative analysis of the durations of the running step phases

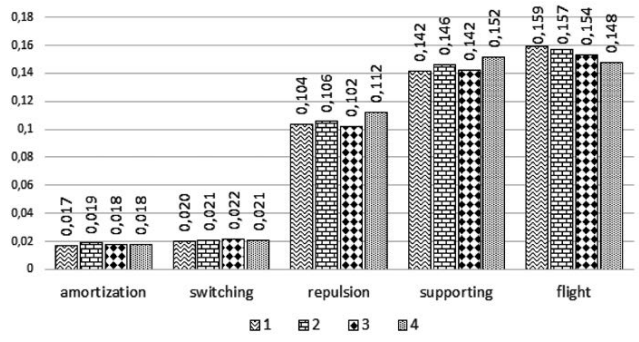
Indicators	Pairs of shooting points					
	1-2	1-3	1-4	2-3	2-4	3-4
Duration of the amortization phase (s)						
1.M.±σ	0,017±0,003	0,017±0,003	0,017±0,003	0,019±0,003	0,019±0,003	0,018±0,004
2. M.±σ	0,019±0,003	0,018±0,004	0,018±0,004	0,018±0,004	0,018±0,004	0,018±0,004
p-val	0,059	0,131	0,154	0,680	0,436	0,67
Switching phase duration (s)						
1.M.±σ	0,020±0,004	0,020±0,004	0,020±0,004	0,021±0,005	0,021±0,005	0,022±0,005
2. M.±σ	0,021±0,005	0,022±0,005	0,021±0,007	0,022±0,005	0,021±0,007	0,021±0,007
p-val	0,463	0,332	0,536	0,693	0,828	0,674
Duration of the repulsion phase (s)						
1.M.±σ	0,104±0,010	0,104±0,010	0,104±0,010	0,106±0,010	0,106±0,010	0,102±0,010
2. M.±σ	0,106±0,010	0,102±0,010	0,112±0,010	0,102±0,010	0,112±0,010	0,112±0,010
p-val	0,305	0,054	**0,009**	0,010	0,066	**0,002**
Duration of the support phase (s)						
1.M.±σ	0,142±0,010	0,142±0,010	0,142±0,010	0,146±0,008	0,146±0,008	0,142±0,009
2. M.±σ	0,146±0,008	0,142±0,009	0,152±0,008	0,142±0,009	0,152±0,008	0,152±0,008
p-val	**0,0001**	0,9271	**0,0004**	**0,00001**	**0,0190**	**0,0003**
Flight phase duration (s)						
1.M.±σ	0,159±0,009	0,159±0,009	0,159±0,009	0,157±0,009	0,157±0,009	0,154±0,010
2. M.±σ	0,157±0,009	0,154±0,010	0,148±0,012	0,154±0,010	0,148±0,012	0,148±0,012
p-val	0,1125	**0,0100**	**0,0001**	**0,0275**	**0,0005**	**0,0217**
Double step phase duration (s)						
1.M.±σ	0,605±0,026	0,605±0,026	0,605±0,026	0,604±0,025	0,604±0,025	0,562±0,097
2. M.±σ	0,604±0,025	0,562±0,097	0,570±0,099	0,562±0,097	0,570±0,099	0,570±0,099
p-val	0,7367	0,0133	0,6308	0,0008	0,7377	0,224

Table 2. Comparative analysis of the lengths and speeds of running steps (2–4)

Indicators	Double step length (m)	Double step speed (m/s)
1.M.±σ	4,248±0,159	7,047±0,237
2. M.±σ	4,020±0,239	6,677±0421
p-val	**0,00002**	**0,0007**

tion phase), the ankle and knee joints bend, the heel or the forefoot (in athletes who place their foot from the heel) move toward the support. In the switching phase, the foot does not move relative to the track, the ankle and knee joints continue to bend. In the push-off phase, the heel begins to move upward. At the end of the switching phase, extension of the knee joint begins, followed shortly thereafter by extension of the ankle joint.

As can be seen from Table 1, the duration of the first two phases on the support remains virtually unchanged during the distance (p>0,05). The duration of the push-off phase increases from the start to the finish. In most of the compared pairs, these differences are reliably significant (p≤0,01), in some cases (1–3, 2–4) they are observed at the trend level (p≤0,066). In almost all compared pairs, the duration of the support phase increases from the start to the finish (p≤0,019). The exception is the absence of significant differences in the duration of the support phase between survey points 1 and 3. It can be assumed that this exception was a consequence of the acceleration of running by most athletes on the section of the distance near point 3 (580 m from the start). Often, before the start of the final turn, athletes reorganize to take more advantageous positions before the finish.



Dynamics of the duration of the running step phases (average values, s)

As can be seen from the graph in the figure, the duration of the flight phase decreases as the distance progresses. In most cases, there are reliably significant differences (p<0,03). The absence of reliable differences in the duration of this phase at points 1 and 2 is apparently due to the fact that fatigue has not yet had an effect on the first lap of the distance.

The duration of the double step does not have reliably significant differences between the beginning (point 1) and the finish (point 4) of the distance (p=0,631), and in most other compared pairs of points. We can say that there is no tendency for this parameter to change as the distance progresses. Perhaps this is due to the multidirectional dynamics of the duration of individual phases of the running step. The reliable decrease in the duration of the double running step (p<0,05) between survey points 1–3 and 2–3, in our opinion, is due to the acceleration of running opposite survey point 3, as mentioned above.

The length and speed of the double step decrease as the distance progresses. The differences in these parameters in the middle and at the finish of the distance have reliable significant differences (p≤0,0007). When determining the lengths of steps, a difference in the length of two adjacent steps constituting a double step is observed (similarly - in other studies [10]). At the same time, there is a tendency for the difference to increase, that is, to increase the asymmetry of steps along the distance. At the end of the first lap, the differences in the length of two steps were 0,066 ± 0,059 m, at the finish – 0,098 ± 0,074 m. Despite the absence of reliable differences (p>0,05), an increase in the asymmetry of steps can characterize the athlete's fatigue at the finish of the distance. The problem of determining which parameters and to what extent change depending on the running speed, and which due to fatigue, has been solved previously [2, 4], but is still relevant, especially when running in competitive conditions. In our study, despite the tendency for the running speed to decrease during the distance (Table 2, Figure), during the finishing acceleration the running speed of some runners increased. Six of the examined athletes showed similar double step speeds in the middle of the distance (point 2 – 380 m from the start) and at the finish (point 4 – 20 m before the finish). The difference was no more than 1,5% (p=0,379). These

athletes showed a reliable decrease in the duration of the flight phase (point 2 – 0,1597±0,007 s, point 4 – 0,1477±0,008 s, p=0,016). The durations of other phases of the running step in the middle and at the finish of the distance did not differ significantly (p>0,05). The duration of the flight phase changed little in the first half of the 800-meter distance (points 1-2, p=0,113). It can be assumed that the duration of the flight phase changes not due to running speed, but due to fatigue. Further research is required to confirm this hypothesis.

Conclusions. The values and dynamics of the 800 m running technique indicators of highly qualified athletes were determined based on high-speed filming under competition conditions. The indicators were identified whose changes over the distance were reliably significant (p<0.05). It was shown that from the start to the finish the duration of the push-off and support phases increases, and the flight phase decreases. The length of the steps (double step) and the speed of the double step significantly (p<0.05) decrease from the middle of the distance to the finish. A tendency towards an increase in the asymmetry of the running step over the distance was found. A hypothesis was put forward that a decrease in the flight phase is largely associated with an increase in fatigue, rather than with a change in running speed. The study demonstrated the possibility of calculating indicators for assessing the technique and fitness of middle-distance runners under competition conditions. To test the hypotheses, further experiments are required to create an instrumental methodology for assessing the technical fitness of athletes. To improve the accuracy of the measurements and simplify the processing of the obtained data, it is advisable to use 3D high-speed video filming.

References

1. Aikin V.A., Koryagina Yu.V. Begovaya ekonomichnost i osobennosti yeye povysheniya u legkoatletov-stayyerov (zarubezhnyy opyt). Nauka i sport: sovremennyye tendentsii. 2014. No. 3. Vol. 4. pp. 86-90.
2. Arakelyan E.E., Tyupa V.V., Mikhaylova O.D., Mnukhina O.N. Biomekhanika utomleniya v bege. Teoriya i praktika fizicheskoy kultury. 2010. No. 1. pp. 66-72.
3. Demidov V.A., Mavliev F.A., Nazarenko A.S., Demidova V.V. Nekotoryye aspekty otsenki effektivnosti bega. Chelovek. Sport. Meditsina. 2018. Vol. 18. No. 4. pp. 7-13.
4. Kryazhev V.D., Dorontsev A.V., Shvetsov A.V., Amelina E.N. Biomekhanicheskiye i bioenergeticheskiye kriterii tekhniki bega na sredniye i dlinnyye distantsii. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2023. No. 1 (215). pp. 267-271.
5. Lysenko E.N. Prognozirovaniye fizicheskoy rabotosposobnosti i reaktsiy kardiorespiratornoy sistemy pri nagruzkakh aerobnogo kharaktera u sportsmenov vysokogo klassa. Vestnik sportivnoy nauki. 2013. No. 4. pp. 33-38.
6. Barnes K.R., Kilding A.E. Running economy: measurement, norms, and determining factors. Sports Medicine – Open.
7. Cavanagh P.R., Williams K.R. The effect of stride length variation on oxygen uptake during distance running. Med Sci Sports Exerc. 1982;14(1):30-5.
8. Cynthia R. Lee, Claire T. Farley Determinants of the center of mass trajectory in human walking and running. The Journal of Experimental Biology 201, 2935-2944 (1998).
9. Pollitt L., Walker J., Tucker C., Bissas A., (2018). Biomechanical Report for the IAAF World Championships 2017: 200 Metres Men. Birmingham, UK: International Association of Athletics Federations.
10. Rachel Mason, Liam T. Pearson, Gillian Barry, Fraser Young, Oisin Lennon, Alan Godfrey, Samuel Stuart Wearables for Running Gait Analysis: A Systematic Review Sports Medicine (2023) 53:241-268.

Self-management in professional orientation for young athletes

UDC 796.011.1

Dr. Hab., Associate Professor **A.G. Gretsov**[1, 2]
[1]Saint-Petersburg scientific-research institute for physical culture, St. Petersburg
[2]The Herzen State Pedagogical University of Russia, St. Petersburg

Corresponding author: skorobey64@mail.ru

Received by the editorial office on 01.07.2024

Abstract

Objective of the study was to reveal the scientifically approved psychological and pedagogical technology for young athletes to manage their professional expectations by themselves for the successful furthermore professional self-determination.

Methods and structure of the research. The research was held on the base of the Institute of Physical Culture of the Herzen State Pedagogical University of Russia. Approximately, 202 students of the 1st and 2nd courses of the Institute, aged 17-20 years (educational programs «Physical Education», «Physical Culture and Health Technologies») had been envolved. Based on the analysis of literary and other information sources, as well as personal teaching experience, the main difficulties that are typical at the stage of the end of the career of an active athlete, when moving to other types of professional activity, were identified. A set of developments was created aimed at preparing young athletes to make a decision about their professional future and psychologically safe passage through the crisis of the end of the career of an active athlete. The developments were scientifically tested finally.

Results and conclusions. Professional self-determination of young athletes is hampered by such factors as: insufficient motivation to resolve this issue and poor understanding of its relevance; low awareness of professions, criteria for their selection, the labor market; insufficient understanding of one's own inclinations and abilities; inability to devote sufficient resources to professional self-determination, since sports activities are a priority. It is advisable to prepare young athletes for further self-determination in the professional sphere not after the end of the period of active training and performances, but in advance, at the age of 16-20: at the same time when most of their peers who are not involved in sports solve similar problems. A technology for its implementation has been developed, including text and illustrative information and methodological materials, 6 psychodiagnostic questionnaires, a program of training sessions (24 hours), and career guidance training. The developments have been tested on a sample of students receiving physical education and sports education.

Keywords: *self-management, students, professional orientations, career expectations, young athletes, sports career*

Introduction. The relevance of the study is related to the specifics of building a career of an active athlete and the fact that after its completion it is necessary to make a decision on further professional self-determination. Achieving significant sports results is possible at a very early age, compared to most areas of activity, when peers are only taking their first steps in professional development. However, the athlete's career also ends quickly (and often unexpectedly).

Next comes work that will be significantly different from what he did at the previous stage of life. Even if it remains directly related to sports (coach, referee, etc.), most sports skills will not be able to be directly transferred to it; a new set of competencies will need to be formed.

The period of the end of the career of an active athlete is reasonably considered a crisis associated with a sharp change in lifestyle and social circle, and in many cases also with a decrease in social status.

Objective of the study was to scientifically substantiate and develop a psychological and pedagogi-

cal technology for preparing young athletes for future professional self-determination.

In this context, psychological and pedagogical technology refers to the means and methods of psychological and pedagogical work with young athletes, as well as a set of information and reference materials used in this regard, aimed at increasing awareness and meaningfulness of the process of professional self-determination and planning of an educational trajectory.

Methods and structure of the study. The work was mainly of a methodological and analytical nature. Based on the analysis of literary and other information sources, as well as personal teaching experience, the main difficulties that are characteristic of the stage of the end of the career of an active athlete, when moving to other types of professional activity, were identified. A set of developments was created aimed at preparing young athletes to make a decision about their professional future and psychologically safe passage through the crisis of the end of the career of an active athlete.

The developments were tested on a sample of 202 1-2 year students of the Institute of Physical Culture of the Herzen State Pedagogical University of Russia, aged 17-20 years (educational programs «Physical Education», «Physical Culture and Health Technologies»).

Results of the study and discussion. The transition from the career of an active athlete to other types of activity has two main contradictions.

1 – the need for successful adaptation of an athlete who has finished performing and the lack of effective technologies for psychological and pedagogical support in this. 2 – poorly developed methods of psychological assistance to athletes at this stage of life and a lack of experimental data that allow substantiating such technologies [4]. The readiness of an athlete to carry out further professional self-determination consists of the following components. 1 – motivational: characterizes the personal attitude to the chosen profession. 2 – cognitive: knowledge about it. 3 – practical: work skills, abilities [2].

When the career of an active athlete comes to an end, a motivational conflict arises between the desire to end it (fatigue, understanding of the lack of prospects, the emergence of other life priorities, etc.) and the unwillingness to lose the benefits that the status of an athlete provides. This is a risk factor in adapting to new living conditions [1]. It is noted that athletes are often «cut off from life» in its everyday, everyday sense, and when faced with everyday problems, they experience difficulties [6].

Programs and methods aimed at psychological support for athletes completing the period of active training and performances are addressed primarily to those for whom this period has already begun. The novelty of our study is that it is proposed to create prerequisites for this in advance, at the same period of life when the decision on professional development is made by most peers who are not athletes (16-20 years old). This age is sensitive for making life plans and thinking about one's future. In addition, most young athletes at this age begin to receive professional education, combining training with training and performances.

In the psychological support of athletes completing the period of active training and performances, an important role should be given to planning future professional activity, «switching» to it. It is important that it turns out to be subjectively no less attractive than sports [5]. Specially organized career guidance work with senior school-age athletes is considered as an effective measure to prevent the crisis of ending a sports career [3].

When preparing young athletes for their future professional activities, they should be helped to form a range of knowledge and skills. 1 - general knowledge about work, self-realization in the profession, types of careers and types of professional activities both in the field of physical education and sports, and in other areas. 2 - skills to analyze the labor market. 3 - the ability to identify life and professional values, ideals, moral foundations of a professional career [7].

To help young athletes make decisions about their professional future, we have developed a series of text and informational and methodological illustrative materials. This is a brochure, the text of which is stylized as free communication with teenagers, as well as 15 posters with explanatory texts and recommendations for specialists on the methodology of their use in career guidance classes. The materials are designed to help young athletes make a conscious and meaningful decision about how to develop professionally after the period of active training and performances is over.

A program has been developed, the purpose of which is to prepare young athletes for future professional self-determination (24 hours). The audience is young athletes aged 16-20. It allows to expand the

understanding of the diversity of professions, including those related to sports, the criteria for their classification, the content of work and the requirements imposed, to plan their future in the professional sphere. Also developed is a scenario of career guidance psychological training for young athletes, including a series of games and group discussions (16 hours), and a set of 6 psychological questionnaires of career guidance orientation, five of which are the author's, and 1 is a modification of the «Differential Diagnostic Questionnaire» by E.A. Klimov taking into account the specifics of sports.

Conclusions. Professional self-determination of young athletes is hampered by such factors as: insufficient motivation to resolve this issue and a weak understanding of its relevance; low awareness of professions, criteria for their selection, the labor market; insufficient understanding of one's own inclinations and abilities; the inability to devote sufficient resources to professional self-determination, since sports activities are a priority. It is advisable to prepare young athletes for further self-determination in the professional sphere not after the end of the period of active training and performances, but in advance, at the age of 16-20: at the same time when most of their peers who are not involved in sports solve similar problems. To improve the effectiveness of preparing young athletes for future professional self-determination, a wide range of methods and means should be used, combining information and educational activities, diagnostics, active methods of psychological and pedagogical support (group discussions, trainings, role-playing games), individual and group career guidance counseling. In our study, the necessary information and methodological materials for this purpose were developed and tested.

References

1. Abramovich I.R., Petukhova A.S. Proyavleniye vnutrilichnostnogo konflikta u sportsmenov, zavershayushchikh karyeru. Uchenyye zapiski Belorusskogo gosudarstvennogo universiteta fizicheskoy kultury. 2013. No. 16. pp. 101-110.
2. Arabadzhi T.D. Strukturnyye komponenty gotovnosti sportsmena k professionalnomu samoopredeleniyu posle okonchaniya sportivnoy karyery. APRIORI. Ceriya: Gumanitarnyye nauki. 2014. No. 6. 2 p.
3. Afonskiy V.I., Selezneva Yu.A., Demchenskaya L.G. K voprosu o professionalnom samoopredelenii sportsmenov, zavershayushchikh svoyu sportivnuyu karyeru. Izvestiya Tulskogo gosudarstvennogo universiteta. Fizicheskaya kultura. Sport. 2021. No. 11. pp. 54-59.
4. Ivanov I.B. Psikhologicheskoye konsultirovaniye kak sredstvo pomoshchi sportsmenam, zavershayushchim i zavershivshim sportivnuyu karyeru. PhD diss. abstract. Moscow, 2009. 22 p.
5. Karyakina T.N., Petrova S.V. Psikhologicheskoye konsultirovaniye kak sredstvo pomoshchi sportsmenam, zavershayushchim sportivnuyu karyeru. Poisk (Volgograd), publ. 2016. No. 1 (3). pp. 30-33.
6. Nikitushkin V.G. Problemy sotsialnoy adaptatsii professionalnykh sportsmenov, zavershivshikh karyeru. Vestnik Moskovskogo gorodskogo pedagogicheskogo universiteta. Seriya: Yestestvennyye nauki. 2014. No. 3 (15). pp. 104-110.
7. Sova E.E. Podgotovki budushchikh spetsialistov fizicheskoy kultury i sporta k professionalnoy karyere. Vestnik Adygeyskogo gosudarstvennogo universiteta. 2010. No. 3. pp. 162-167.

Methodological recommendations for choreographic training of young acrobats

UDC 796.015.132

Postgraduate student **A.M. Shelgacheva**[1]
PhD, Associate Professor **L.M. Bezhentseva**[1]
Postgraduate student **D.S. Kim**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: vshilko@mail.ru

Received by the editorial office on 04.07.2024

Abstract

Objective of the study was to provide a scientific basis for the efficacy of the application of the method of choreographic training for young acrobats during the initial training phase.

Methods and structure of the study. Experimental work was carried out on the basis of MAU DO Youth Sports School No. 3 in Tomsk in the 2022/2023 academic year. The study involved 30 young acrobats training in initial training groups (15 in the experimental group - EG and 15 in the control group - CG). The training process in the CG was carried out in accordance with the current program, and in EG - according to a developed training methodology with the predominant use of choreographic training (ground gymnastics, Pilates and stretching) aimed at developing ballet step, eversion and lifting of the feet, strength of the leg muscles and flexibility of the spine.

Results and conclusions. During the classes, the method of group work was used, which helped equip acrobats with ideas about the main points and lines of the hall, forms of formations and changes, development of the ability to «feel a partner» and navigate in space. The results of testing the special motor readiness of young acrobats from the EG and CG made it possible to establish reliable intergroup differences during the experiment in indicators assessing flexibility, jumping ability, and maintaining static balance.

Keywords: *acrobatics, young athletes, choreographic training, motor skills, initial training stage*

Introduction. The ever-increasing level of competition in sports acrobatics necessitates a continuous search for ways to improve the methodology of sports training in general and its individual components.

It is generally recognized that only athletes with a high culture of movement are able to perform coordination and technically complex exercises easily and naturally, where it is possible to evaluate the amplitude of movements, the beauty of lines, artistry and expressiveness of performance [4]. All these tasks are solved with the help of choreographic training, which, as noted by many experts, contributes to the development of motor memory, coordination and consistency of movements, jumping ability, flexibility, muscle strength, expressiveness and artistry [2].

Therefore, in order to achieve all the above results, it is advisable to begin choreography classes already at the stage of initial training. As a rule, the basis of choreographic training in aesthetic sports is classical ballet choreography, but its full use is recommended to begin from the age of 9-10 years, which coincides with the transition of athletes to the next (training) stage of training [1]. Early initiation of classical exercises at the machine can have a detrimental effect on the athlete's health, due to the immature muscular corset and unpreparedness to localize the work of the necessary muscles [3]. Therefore, at the initial training stage, one of the most important tasks of the trainer is competent, comprehensive and safe preparation of young athletes for increasing loads.

Objective of the study was to provide a scientific basis for the efficacy of the application of the method of choreographic training for young acrobats during the initial training phase.

Methods and structure of the study. Experimental work was carried out on the basis of MAU DO Youth Sports School No. 3 in Tomsk in the 2022/2023 academic year. It involved 30 young acrobats studying in initial training groups (15 in the EG and 15 in the CG). To complete the EG and CG, a preliminary stage of the pedagogical experiment was carried out in order to determine the homogeneity of the groups in terms of physical fitness and the degree of mastery of motor skills and abilities.

The training process in the CG was carried out in accordance with the current program, and in the EG - according to the developed method of choreographic training with the predominant use of means from ground gymnastics, Pilates and stretching, aimed at developing ballet step, eversion and lifting of the feet, strength of the leg muscles and flexibility of the spine.

Results of the study and discussion. At the ascertaining stage of the pedagogical experiment, it was determined that most acrobats failed to perform exercises for flexibility and coordination of movements. Based on the results of preliminary studies, we developed and implemented in the educational process the content and methodology of choreographic training for young acrobats at the initial training stage.

As part of the developed methodology, the following sets of exercises are proposed:

- a set of floor gymnastics;
- a strength set of exercises based on exercises from the Pilates system;
- a set for developing the flexibility of the spine and mobility of the shoulder girdle, as well as the hip, knee and ankle joints;
- a set aimed at developing the coordination abilities of athletes.

All of the above sets of exercises can be performed both separately and together, alternating with each other. The training process for young athletes was based on the following methodological provisions:

- a set of floor gymnastics is performed in the preparatory part of a 45-minute training session and is aimed not only at preparing the body for training effects, but also at setting the correct position of body parts in space, including a long neck, straightened shoulders, "soft" arms, a straight back, retracted knees and everted stretched feet. And also at working out the muscles of the legs, back and abdominal press.

- complex choreographic training was a set of exercises of classical exercises on the floor, rhythmic gymnastics and acrobatics exercises, dance combi-

Results of testing special motor training of young acrobats, $\overline{X} \pm \sigma$

Tests	Direction	The value of the indicators before the pedagogical experiment		The significance of the indicators after the pedagogical experiment	
		CG	EG	CG	EG
Balance standing on the right leg, points	Forward	3,2±0,4	3,2±0,4	3,3±0,5	4,3±0,5 *
	To the side	3,2±0,4	3,3±0,5	3,6±0,7	4,5±0,5 *
	Back	4,0±0,7	4,0±0,5	4,4±0,6	5,0±0,6 *
Balance standing on left leg, points	Forward	3,2±0,4	3,5±0,5	3,6±0,5	4,1±0,3 *
	To the side	3,6±0,5	3,7±0,4	3,7±0,7	4,3±0,5 *
	Back	4,0±0,7	4,2±0,4	4,3±0,6	5,5±0,5*
Jump into longitudinal split, points	-	4,5±0,5	4,6±0,5	4,3±0,5	5,8±0,6*
Jump up with 360 degree turn, points	-	4,6±0,5	4,6±0,5	4,7±0,4	5,0±0,8*
Splits from a height of 40 cm	Right	3,2±0,4	3,5±0,5	3,5±0,4	4,5±0,5*
	Left	3,6±0,5	3,7±0,4	3,5±0,5	4,9±0,4*
	Longitudinal	4,0±0,7	4,2±0,4	4,3±0,7	4,7±0,4*
Gymnastic bridge, points		4,5±0,5	4,6±0,5	4,2±0,5	5,9±0,5*

** - statistically significant differences between indicators compared to the control group, p≤0,05*

nations, free plastic exercises, varieties of walking and running, as well as sets of exercises from Pilates and stretching;

- taking into account motor asymmetry: each motor action was performed equally in each direction with both legs and arms.

When performing floor gymnastics exercises, the following rules and recommendations were followed:

- mandatory warm-up of muscles before performing exercises;
- slow and smooth execution of flexibility and stretching exercises;
- performing exercises until slight pain;
- «straight back rule»;
- calm breathing;
- symmetrical execution of stretching exercises for both sides of the body;
- performing floor gymnastics exercises from sitting and lying positions.

In order to develop musicality and the formation of the ability to reproduce rhythm, as well as to coordinate movements with the character and content of music, the means of the artistic component were used: musical and rhythmic tasks and musical games.

The classes used the method of group work, helping to equip acrobats with ideas about the main points and lines of the hall, the forms of formations and reorganizations, the development of the ability to «feel a partner» and navigate in space. The leading means of the group method were active games, stylized general development exercises performed in pairs, threes, groups, synchronously, on the spot and in motion, with a change in the main direction.

Analyzing the results of testing the special motor readiness of young acrobats of the EG and CG, presented in the table, it can be stated that reliable intergroup differences during the period of the experiment are observed in the indicators assessing flexibility, jumping ability, and maintaining static balance.

Conclusions. The obtained results allow us to speak about the effectiveness of the application of the developed method of choreographic training in order to increase the level of special motor training of young acrobats at the initial training stage.

References

1. Amurskaya O.V., Strelkova Ya.A., Prokopenko A.V. Gimnastika v sisteme fizicheskogo vospitaniya obrazovatelnykh uchrezhdeniy. Study methodological guide. Belgorod: OGAOU DPO «BelIRO» publ., 2020. 112 p.
2. Bezhentseva L.M. Khoreograficheskaya podgotovka akrobatok na etape sportivnogo sovershenstvovaniya. Teoriya i praktika fizicheskoy kultury. 2020. No. 10. pp. 24-25.
3. Bezhentseva L.M. Formirovaniye dvigatelnykh sposobnostey yunykh sportsmenok sredstvami esteticheskoy gimnastiki. Teoriya i praktika fizicheskoy kultury. 2017. No. 8. pp. 89-90.
4. Kolesnikova E.S. Metodika sovershenstvovaniya opornogo pryzhka povyshenngo urovnya slozhnosti s ispolzovaniyem razlichnykh vspomogatelnykh konstruktsiy v zhenskoy sportivnoy gimnastike. Aktualnyye problemy i tendentsii razvitiya gimnastiki, sovremennogo fitnesa i tantsevalnogo sporta. Proceedings of the All-Russian scientific-practical conference. Moscow: RGUFKSMiT publ., 2020. pp. 65-70.

The evolution of physical attributes of the basketball players from the student team of the chinese university, through the lens of functional training

UDC 796.323

Postgraduate student **Yuy Tszyun**[1]
Dr. Hab., Professor **V.S. Makeeva**[1]
Dr. Hab., Professor **S.V. Chernov**[1]
[1]The Russian University of Sport «GTSOLIFK», Moscow

Corresponding author: 1041060816@qq.com

Received by the editorial office on 13.06.2024 г.

Abstract

Objective of the study was to empirically validate the enhancement of the physical abilities of the male basketball players from the Chinese university team through the implementation of functional training.

Methods and structure of the study. In the course of the research, the physical attributes, agility, reaction time, and stamina of 15 male basketball players from the Heihe University team were assessed. A tailored training regimen was devised. The participants engaged in a 14-week program, with daily workouts lasting approximately 90 minutes. For a comparative evaluation of physical parameters, a group of 49 basketball players from the Division I of the Chinese Student Basketball Association (CUBA) in the 2022-2023 season was selected.

Results and conclusions. Following the functional training, the players of Heihe University's men's basketball team demonstrated substantial improvements in their strength capabilities (<0,001), speed attributes (<0,001), and endurance (<0,001), indicating the effectiveness of the training program.

Functional training is a crucial component in the development of specific physical attributes for basketball players. It has a positive impact on enhancing the flexibility and stability of the upper body, improving statokinetic functions, developing explosive power, maintaining a low center of gravity, and facilitating rapid acceleration, technical adjustments, and endurance.

Keywords: *college basketball players, physical quality, information, reliability, athletic performance*

Introduction. In basketball competitions, the key factor determining victory or defeat in the game is the athletes' abilities, which are associated with special physical qualities, anthropometric parameters, and functional state [2,3]. As a result of a survey of coaches and athletes from 12 teams of the Chinese student men's basketball league, it was found that university basketball teams do not pay enough attention to special training for the development of the physical qualities of basketball players, and, as a rule, equate general physical training with special [4]. The university stage of training is a key period of high growth of special physical abilities of basketball players, so their development has important theoretical significance and practical value.

Objective of the study was to empirically validate the enhancement of the physical abilities of the male basketball players from the Chinese university team through the implementation of functional training.

Methods and structure of the study. The study tested the strength, speed, reaction speed, and endurance of 15 basketball players from the Heihe University men's basketball team. It was found that the participants had high strength and low speed and endurance. In this regard, a functional training program was developed (Table 1). The subjects underwent a 14-week experiment with daily training lasting about 90 minutes. A group of 49 basketball players from the 2022-2023 Chinese Collegiate Basketball Association

(CUBA) Division I was taken for a comparative analysis of physical indicators.

It is important to note that functional training for basketball players focuses on specific muscles or muscle groups. At the same time, functional training can help athletes improve motor function and balance, prevent injuries, and improve long-term performance.

Results of the study and discussion. Table 2 presents a comparative analysis of the physical performance of the Heihe University men's basketball team and the Division I team.

Analyzing the data in Table 2, it can be noted that the athletes of the Heihe University men's basketball team are superior to the athletes of the first division in strength qualities. This indicates that they have a higher adaptability to a power confrontation. In attack, players can use their strength advantage to break through opponents and take rebounds. In defense, players have sufficient strength abilities to withstand opponents' throws and limit their chances of winning. On the other hand, the participants of the Heihe University men's basketball team are below the average level of the first division in the speed of reaction to changes in the pace of the game and the speed of movement. This means that they do not keep up with their opponents and cannot react in a timely manner to sudden situations during the game, which affects their results. In attack, with insufficient speed reactions, players will be limited in attack, which makes it difficult to effectively break through the defense and score points.

As the results of the comparative analysis showed, the endurance parameter of the athletes of the Heihe University men's basketball team is lower than that of the players of the first division team. Thus, a low level of endurance over a long season can lead to basket-

Table 1. Functional training program of Heihe University men's basketball team

Days of the week	Focus of training	Content
Monday	Upper Body Strength	1. Bench Press (70%-80% of 1RM of bodyweight to complete 5 reps/5 sets) 2. Power Press (60%-70% of 1RM of bodyweight to complete 6-8 reps/4 sets) 3. Unilateral Dumbbell Overhead Press (each side of bench press 70%-80% of 1RM25% of bodyweight to complete 5 reps/5 sets) 4. Borrowed Dumbbell Press (each side power press 60%-70% of 1RM25% of bodyweight to complete 10 reps/4 sets) 5. Triceps Extension (find a weight that allows you to push yourself to failure, complete 15 reps/4 sets)
Tuesday	Lower limb strength	1. Contrast Training (86%-90% 1RM to perform 3-5 reps of fast centripetal squats) Loaded Squat Jumps (30% 1RM or less to perform 6-8 reps of squat jumps) 4-5 sets 2. Single Leg Push-Ups with Hard Rows (6 reps per side 4/sets) 3. Lateral Lunges with Sliding Plate (8 reps per side/4 sets) 4. Nordic Snatches (8 reps/4 sets)
Wednesday	Functional improvement of the upper limbs + heart training	1. Unilateral Dumbbell Dead Bug Press (12 reps/4-5 sets per side) 2. Unilateral Single Leg Dumbbell Press (10-12 reps/4-5 sets per side) 3. Unilateral Dumbbell Overhead Raises (10-12 reps/4 sets per side) 4. Unilateral Standing Row (10-12 reps/4 sets per side)
Thursday	Functional improvement of the lower limbs + heart training	1. Squats with foot raise and reverse rotation (10-12 reps/4-5 sets per side) 2. Single-leg weighted squats with front lunge (10-12 reps/4-5 sets per side) 3. Single-leg step-down squats (8-10 reps/4 sets per side) 4. Single-leg weighted step-down squats (8-10 reps/4 sets per side)
Friday	Explosive Power + Core Workout	1. Jump Squats (12 reps/5 sets) 2. Jump Ankle Extensions (20 reps/5 sets) 3. Squat Pushdown with Resistance Band (8-10 reps/4 sets) 4. Kettlebell Lifting (12-15 reps/4 sets) 5. Oscillating Anti-Rotation Movements (10-12 reps/4 sets) 6. Supported Ab Wheel (10-12 reps/4 sets)
Saturday	Endurance training	Morning: 5 x 6-minute runs (1-minute intervals between sets), requiring a lactate concentration of no more than 2.5 mmol/L. Evening: 10 x 3-minute runs (30-second intervals between sets), requiring a lactate concentration of no more than 3.5 mmol/L.
Sunday	Rest	Rest and do some low-intensity recovery workouts such as yoga, stretching, etc. to help your body recover and prepare for next week's workouts.

Table 2. Comparative analysis of the performance of the Heihe University men's basketball team and the Division I team

Indicator	Heihe University (N=15)	Division I (N=49)
Medicine Ball Throw (m)	14,46±0,49	14,26±0,64
T-type test (c)	10,03±0,12	9,88±0,10
Cooper Test (m)	2869,80±49,56	2981,77±61,85

Table 3. Data of comparative analysis of test results before and after the experiment of the participants of the basketball team of Heihe University

Indicator	Heihe University		t	p
	before	after		
Medicine Ball Throw (m)	14,46±0,49	14,61±0,53	-5,228	<0,001
T-type test (c)	10,03±0,12	9,88±0,08	6,330	<0,001
Cooper Test (m)	2869,80±49,56	2951,47±50,27	-16,826	<0,001

ball players becoming tired at the end of a game and can affect their ability to cope with opponents and make decisions. Athletes with low levels of endurance may demonstrate less speed and explosiveness during a game, which can affect their ability to score and play defense, thereby affecting the outcome of the game for the team as a whole (Table 3).

After functional training, the basketball players of the Heihe University men's basketball team showed significant differences in strength (<0.001), speed (<0.001), and endurance (<0.001), which indicates the effectiveness of functional training.

Conclusions. Functional training plays an important role in the development of special physical qualities in basketball players, which is expressed in its positive, targeted impact on improving the flexibility and stability of the upper limbs, improving statokinetic functions, special explosive power, the ability to maintain a low center of gravity, which allows for a rapid increase in speed and change of technical actions and endurance.

References

1. Liu Qingsun Study of the influence of strength training on the physical fitness and basic skills of male basketball players. Guangzhou Institute of Physical Education. 2016. No. 36(02). pp. 81- 84.
2. Makeeva V.S., Chernov S.V., Yuy Ts. O faktorakh, opredelyayushchikh obespecheniye informatsionnoy nadezhnosti basketbolistov studencheskikh komand [On the factors determining the provision of information reliability of student basketball players]. Nauka v zhizni cheloveka. 2022. No. 2. pp. 123-130.
3. Makeeva V.S., Chernov S.V., Yuy Ts. Modelirovaniye informatsionno-analiticheskoy kompetentnosti budushchego trenera v protsesse obucheniya v profilnom vuze [Modeling the information and analytical competence of a future trainer in the process of training at a specialized university]. Mir nauki. Pedagogika i psikhologiya. 2023. Vol. 11. No. 2.
4. Zhao Zhiming Study of the basic principles and methods of physical training in basketball. Xi'an Institute of Physical Culture. 2007. No. 5. pp. 81- 85.
5. Yuy Ts., Makeeva V.S., Chernov S.V. Informatsionnaya nadezhnost pokazateley dlya otbora basketbolistov kitayskoy universitetskoy muzhskoy basketbolnoy ligi (CUBA) [Information reliability of indicators for the selection of basketball players in the Chinese university men's basketball league (CUBA)]. Teoriya i praktika fizicheskoy kultury. 2024. No. 6. pp. 99-101.

Biological foundations of optimization of training loads of athletes

UDC 796.422.12+796.015

Postgraduate student **Mintszyunke Shan**[1]
M.S. Kozhedub[1]
Dr. Hab., Professor **E.P. Vrublevskiy**[1, 2]
[1]Skorina Gomel State University, Gomel, Belarus
[2]Smolensk State University of Sports, Smolensk, Russia

Corresponding author: vru-evg@yandex.ru

Received by the editorial office on 12.01.2024

Abstract

Objective of the study was to consisted in studying the main approaches of the coaches of Belarus and China to taking into account the biorhythmological characteristics of the athletes' body when planning their training process and determining the dynamics of the manifestation of speed and strength abilities during the OMC among athletes specializing in various sports.

Methods and structure of the study. A questionnaire was developed and a survey was conducted of coaches (n=16) involved in the training of track and field athletes in the Republic of Belarus and specialists (n=12) who train hockey players in China. Also, to determine the well-being, changes in mental state, performance, tolerance of training and competitive loads in various phases of the body's biorhythmics, a survey and testing of 18 qualified Belarusian runners at various distances and 23 Chinese female athletes involved in hockey were conducted.

Results and conclusions. Analyzing the data of the coaches' questionnaire, it can be stated that most specialists, when planning the training process, do not take into account the phase of the ovarian-menstrual cycle of athletes, which negatively affects the tolerability of the proposed loads, the functional state and well-being of girls. The results of the survey and the results of testing of athletes indicate the presence of significant phase changes in the indicators of motor abilities of runners and hockey players in each of the phases of the OMC.

Keywords: *sportswomen, training, questioning, features of the female body, OMC.*

Introduction. It is known that the adaptation processes and activity of functional systems in the female body differ from those in men, which is due to the main biological feature of the female body - the presence of the reproductive function, which is quite complex in its neurohumoral regulation [4, 5]. Research by many authors has shown that the cyclicity of the ongoing processes corresponds to the phases of the biological rhythm and affects not only the general condition of the female body, but also its individual organs and systems, which largely determines the performance and the extent of the manifestation of motor qualities in female athletes [2, 3, 6, 7]. Thus, it is obvious that in practical activities, coaches need to take into account the biorhythmological features of the body of a particular athlete, which significantly affect athletic performance.

Objective of the study was to study of the main approaches of coaches from Belarus and China to taking into account the biorhythmological characteristics of the body of female athletes when planning their training process and determining the dynamics of the manifestation of speed-strength abilities during the OMC in athletes specializing in various sports.

Methods and structure of the study. A questionnaire was developed and a survey was conducted among coaches (n=16) involved in training female athletes in the Republic of Belarus and specialists (n=12) who train female hockey players in China. Also, to determine self-assessment of well-being, changes in mental state, performance, tolerance of training and competitive loads in various phases of the body's biorhythms, a questionnaire and testing were conducted among 18 qualified Belarusian runners of

various distances and 23 Chinese athletes involved in hockey. The age of the subjects is 16-20 years, and their sports experience is 3-9 years.

Results of the study and discussion. The analysis of questionnaires of coaches from Belarus and China allowed us to obtain the following data. Thus, 68.8% of the surveyed Belarusian and 58,3% of Chinese specialists, when planning their work, do not take into account the phases of the female athletes' menstrual cycle. Accordingly, 12,5 and 16,7 percent do take into account, and 18,8 and 25,0% use information about the cycle partially, depending on the characteristics of its course. It is characteristic that 75,0% of respondents from Belarus and 83,3% from China are convinced of the mandatory conduct of training sessions in the menstrual phase, the rest do not see the need for this or approach the solution of this issue individually, depending on the athlete's well-being.

The respondents expressed the following opinions on the optimal amount of load in the menstrual phase of the menstrual cycle. Thus, 43,8% of Belarusian and 41,7% of Chinese coaches believe that training impacts during this period should be reduced by half, respectively 25,0 and 16,7% reduce the volume of the load by 20-30 percent from the maximum, the remaining respondents of the two countries do not change the planned volume depending on the psychophysiological and physical condition of the athletes. It was revealed that 56,3% of Belarusian and 58,3% of Chinese coaches consider the use of imitation exercises of a technical nature, aimed to a greater extent at developing flexibility, to be effective in the menstrual phase. At the same time, 18,8% of runners' coaches and 25,0% of hockey players believe that general physical training classes are more productive in this phase. Without exception, all Belarusian and Chinese specialists note the presence of psychophysiological changes occurring in the body of female athletes in the menstrual and, especially, in the premenstrual phase. Most often (as indicated by 81,3% of coaches in Belarus and 66,7% of coaches in China), this manifests itself in the fact that their trainees become irritable and psychologically unstable. Some athletes (18,8 and 16,7%, respectively) experience some lethargy, apathy towards the training process, lack of confidence in their abilities, and sometimes fear and reluctance to participate in competitions. Many coaches (56,3% of Belarusian and 66,7% of Chinese) have personal experience working with athletes whose OMC has virtually no effect on the effectiveness of the training process. The remaining specialists in the two countries claim that absolutely all of their trainees are significantly susceptible to the impact of the body's biorhythms on sports activities. 75,0% of the surveyed specialists in Belarus and 83,3% in China confidently stated that a female athlete with somatic and psychological properties typical of men can achieve success in sports.

Thus, the coaches of the two countries do not have a single conceptual opinion in the approach to planning the educational and training process of female athletes in terms of biorhythmological features of the body and determining the optimal state in which it is possible to set the necessary training effects.

To study the course of the menstrual function and its relationship with the psychophysiological state of girls in various phases of the body's biorhythms, a survey of female athletes from two countries was conducted. During the experiment, they recorded the state of the body in self-monitoring diaries every day, and we kept a log of the subjects' biological cycle.

An analysis of the questionnaire data shows that the RB runners began to play sports at 10,3 years old, the PRC hockey players at 9,5 years old, and the OMC stabilized in most girls from both countries by the age of 14-15. The duration of the OMC in 55,6% of runners and 56,5% of hockey players is 27-29 days. Accordingly, 22,2% and 30,4% have 23-26 days, 16,7% and 8,7% have 21-22 days, and 5,6% and 4,3% have more than 30 days.

It should be emphasized that a shortened OMC (21-22 days) is difficult in itself for planning the training process, and the presence of any violations of the specific biological cycle in an athlete exacerbates these difficulties.

The duration of menstruation in 68,3% of all surveyed athletes is five days, 14,6% - four days, 9,8% - three days, 7,3% - six to seven days. At the same time, 85,4% of athletes feel worse before and during menstruation, pain in the pelvis, headaches. Reduced performance accompanies the premenstrual phase in 65,9 percent of respondents and the menstrual phase in 87,8 percent of respondents. All athletes participate in competitions regardless of the cycle phase, however, 85,4% of girls note that during menstruation this causes faster and deeper fatigue, and the recovery process takes longer than usual.

Analysis of data on the psycho-emotional state showed the following. 26,8% of respondents complain of increased fatigue, imbalance and unreasonable irritability in the first phase (menstrual), 4,9% in the second (postmenstrual), 12,2% in the third (ovulatory), 7,3% in the fourth (postovulatory) and 48,8% in the fifth (premenstrual). According to the subjective feelings of female hockey players, their physical and emotional state worsens in the ovulatory, premenstrual and menstrual phases of the cycle, against which precise spatial orientation decreases, muscle sensations worsen, the time when athletes play slowly increases, and, consequently, the performance of individual players and the team as a whole decreases. As for runners, according to their perception, the best manifestation of special motor qualities is expressed in the II and, especially, IV phases of the cycle, while in the I, III and V phases there is a decrease in the implementation of dominant abilities. It is characteristic that, according to research data [1, 3, 7], it is the postmenstrual (II) and postovulatory (IV) phases of the cycle that are characterized by a high level of hormone concentration. Interesting data were obtained when analyzing the results of the Abalakov vertical jump, which the athletes performed daily before and after training (see table). Not only the phase of the OMC in which the jump test was conducted was taken into account, but also the volume and direction of training effects during this period.

It was found that the height of the vertical jump before training fluctuates on different days of the cycle in athletes from two countries from 38,2 to 45,0 cm, after training – from 35,8 to 43,9 cm. In both cases, the lowest results are shown in the menstrual (I), and the highest - in the postovulatory phase (IV). It is significant that the greatest difference is recorded in the jumps that were performed after training, and the greatest variability of indicators is observed in the menstrual phase. Moreover, the most significant variation is recorded after training, which is associated with both the implementation of training effects of different volume and direction, and with the individual reaction of the athlete's body to them.

Thus, the data of the study indicate the presence of phase changes in the indicators of motor abilities of athletes during the OMC, and the strongest effect of training loads on their motor potential is observed during unfavorable phases of the body's biorhythms.

Conclusions. It can be stated that in their work with the female contingent, coaches do not focus on the OMC, which negatively affects the functional state of athletes and, as a result, their athletic performance. At the same time, the training process organized taking into account the biorhythmological features of the female body will not only ensure higher overall performance, the proper level of special training of athletes, but will also preserve their reproductive health. At the same time, monitoring the individual dynamics of the functional indicators of a specific athlete in various phases of the biological cycle and, in this regard, the individualized focus of the applied training effects, largely optimize strategic approaches in preparation for the main competitions of the season.

References

1. Vrublevskiy E.P. Individualizatsiya trenirovochnogo protsessa sportsmenok v skorostno-silovykh vidakh legkoy atletiki. Moscow: Sovetskiy sport publ., 2009. 232 p.
2. Kozlov A.V., Budarnikov A.A., Zhuravleva Yu.S. Planirovaniye trenirovochnoy nagruzki v pauerliftinge s uchetom biologicheskikh osobennostey organizma sportsmenok. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2018. No. 2 (156). pp. 101-107.

Indicators of vertical jump height (cm) in different phases of the OMC in female athletes

Phases OMC	Before training		After training	
	Runners	Hockey players	Runners	Hockey players
	$\bar{X}$ ±S	$\bar{X}$ ±S	$\bar{X}$ ±S	$\bar{X}$ ±S
I	39,7±2,8	38,2±2,5	36,5±2,7	35,8±2,9
II	43,4±1,1	42,2±1,6	42,8±1,0	41,9±1,8
III	41,1±1,3	40,1±1,7	39,3±1,5	38,7±1,9
IV	45,0±1,2	44,2±1,6	43,9±1,4	43,1±1,6
V	40,3±2,0	40,6±2,1	37,2±2,3	38,3±2,1

3. Kostyuchenko V.F., Vrublevskiy E.P., Kozhedub M.S. Vliyaniye bioritmiki organizma kvalifitsirovannykh sportsmenok na dinamiku ikh dvigatelnykh sposobnostey. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2018. No. 4 (158). pp. 159-164.
4. Nikitushkin V.G. Zhenskiy sport. Textbook for universities. Moscow: Yurayt publ., 2022. 277 p.
5. Shakhlina L.Ya.-G. Mediko-biologicheskiye osnovy sportivnoy trenirovki zhenshchin. Kyiv: Nauk. dumka publ., 2001. 326 p.
6. Shakhlina L.Ya.-G. Osobennosti funktsionalnoy adaptatsii organizma sportsmenok vysokoy kvalifikatsii k bolshim fizicheskim nagruzkam. Sportivna meditsina. 2012. No. 1. pp. 20-30.
7. Sevdalev S.V., Kozhedub M.S., Vrublevskiy E.P., Mitusova E.D. Biorhythm-based individualization of training of female different distance runners. Teoriya i praktika fizicheskoy kultury. 2020. No. 5. pp. 83-85.

The evolution of performance indicators in high-intensity and high-speed training for boys aged 10 to 13, with varying levels of physical activity

UDC 796.422.12

Postgraduate student **Chzhu Khuasin**[1]
Postgraduate student **Nyu Yindon**[2]
Dr. Hab., Professor **E.P. Vrublevskiy**[1, 3]
[1]Skorina Gomel State University, Gomel, Belarus
[2]Polessky State University, Pinsk, Belarus
[3]Smolensk State University of Sports, Smolensk

Corresponding author: vru-evg@yandex.ru

Received by the editorial office on 10.04.2024

Abstract

Objective of the study was to discern the effects of age on the performance metrics of speed and power-speed fitness in boys aged 10 to 13, with varying levels of physical activity.

Methods and structure of the study. The students of the school in Qinhuangdao (China) took part in the scientific work. Starting at the age of 10, 83 students were tested for three years at the end of the school year. At the same time, 42 boys were engaged in the school athletics section, and the rest did not play sports. The dynamics of speed and speed-strength abilities were determined using tests that are widely described in the specialized literature and recommended for assessing the physical fitness of schoolchildren of various ages [1, 5, 7].

Results and conclusions. Additional and purposeful motor activity contributes to a faster mastery of the required level of physical fitness by boys aged 10-13 years, and the predominant effect on their motor abilities, which are at the stage of accelerated age development, leads to significant shifts in the development of the latter. To increase the speed abilities of boys, the most favorable age is 10-11 years old, and speed and strength - 12-13 years old.

Keywords: *schoolchildren aged 10-13, speed and speed-strength abilities, young athletes, dynamics.*

Introduction. Numerous scientific studies indicate that each period of school age has its own characteristics, which must be taken into account when developing methods and organizing classes, selecting means and methods of pedagogical influence and their correlation in the most favorable age periods for this [1, 3, 4].

A significant difference between longitudinal studies and “cross-sections” is the ability to analyze the dependence of the current state of a certain indicator on its state for a specific period of time, which makes it possible to construct “norms” for age-related changes.

Objective of the study was to identify age-related changes in indicators of speed and speed-strength readiness of boys 10-13 years old with different amounts of motor load.

Methods and structure of the study. Pupils from a school in Qinhuangdao, Hebei Province (China) took part in a longitudinal study. Starting at the age of 10, 83 schoolchildren (born in January-March) were tested at the end of the school year for three years. At the same time, 42 boys were involved in the school athletics section, and the rest did not play sports. Speed abilities were assessed by the time of running 20 m on the move and 30 m from a high start, speed-strength abilities were assessed by the results in the standing long jump and triple jump, standing high jump, pushing off with two legs (according to Abalakov), and long jump from a run and throw a medicine ball (1 kg) forward from behind the head.

Results of the study and discussion. As can be seen from the table, the speed and speed-strength abilities of boys aged 10-13 years are constantly changing throughout the age period under consideration, and the latter occurs unequally and unevenly. Thus, speed abilities, which we assessed by running a

20-meter segment on the run, increase up to 11 years, after which the running time improves slightly even among those involved in athletics. A decrease in the increase in results in the 20-meter run by the age of 13 does not mean that an increase is impossible at this age stage. This indicates the need for careful selection of means and methods for developing speed abilities. The overall increase in results over three years was 0,51 s (13,6%) for young track and field athletes and 0,36 s (9,6%) for those not involved in sports. Thus, it can be assumed that the training-based gain in this test exercise was 4,0%.

The picture is approximately the same when analyzing the dynamics of the result in the 30 m run from a high start. A more significant improvement in results is observed from 10 to 11 years, and then the annual increase in running time decreases. In general, the difference between the two groups over three years was slightly greater than in the previous test (5,6%), which can be explained not only by the greater motor activity of young athletes, but also by better mastery of running technique from the start.

The standing long jump results for boys are constantly increasing over the period of longitudinal observations, and the most significant growth is observed from 12 to 13 years, where the increase in results, compared to the previous year, was 15,1 cm for young athletes, and for their peers 10,7 cm ($p<0,05$). In general, over a three-year period, the changes in young athletes in this test amounted to 40,3 cm (27,4%), and among their peers - 20,5 cm (11,1%). The increase due to training influences is 16, 3%.

Indicators in the triple jump at the ages of 10 to 13 years increase evenly and over three years of training, young athletes add 53,2 cm to the initial result, and those boys who do not play sports only 36,0 cm, which in percentage terms is, respectively, 9,8 and 6,6%.

This is the smallest increase in results over three years of all the tests analyzed.

An analysis of the dynamics of results in the standing high jump, pushing off with both legs, shows that from 10 to 13 years of age there is a steady increase in the ability of boys to demonstrate explosive power. But if in the first year this indicator among young track and field athletes increases by 10,3%, and among those who did not engage in sports by 6,3% ($p<0,05$), then in the period from 12 to 13 years a decrease in the increase in the indicator was recorded explosive force. In general, both groups showed the largest increase in the tests we used – 28,1% in the sports group and 17,4% in peers. Thus, if at the age of 10 the initial result was almost the same, then we can assume that the influence of specialized motor load by the age of 13 was 10,7%.

Dynamics of results in tests assessing speed and speed-strength abilities in schoolchildren aged 10–13 years, involved (1) and not involved (2) in sports

Tests	Groups	Changes in indicators by year											
		10 years	11 years			12 years			13 years			Change over 3 years	
		$\bar{X}$	$\bar{X}$	growth	%	$\bar{X}$	growth	%	$\bar{X}$	growth	%	growth	%
Running 20 m on the move, s	1	3,74	3,48	0,26	6,9*	3,35	0,13	3,7	3,23	0,12	3,6	0,51	13,6*
	2	3,75	3,61	0,14	3,7	3,49	0,12	3,3	3,39	0,10	2,9	0,36	9,6*
30m sprint from a high start, s	1	5,88	5,59	0,29	4,9*	5,32	0,27	4,8*	5,11	0,21	3,9	0,77	13,1*
	2	5,86	5,66	0,20	3,4	5,51	0,15	2,7	5,42	0,09	1,6	0,44	7,5*
Standing long jump, cm	1	146,9	158,7	11,8	8,0*	172,1	13,4	8,4*	187,2	15,1	8,8*	40,3	27,4*
	2	145,8	150,3	4,5	3,1	155,6	5,3	3,5	166,3	10,7	6,9*	20,5	11,1*
Standing triple jump, cm	1	545,4	560,4	15,0	2,8	578,2	17,8	3,2	598,6	20,4	3,5	53,2	9,8*
	2	543,6	550,2	6,6	1,2	561,3	11,1	2,0	579,6	18,3	3,2	36,0	6,6*
Standing high jump, pushing off with both legs, cm	1	34,9	38,5	3,6	10,3*	42,5	4,0	10,4*	44,7	2,2	5,2*	9,8	28,1*
	2	35,1	37,3	2,2	6,3*	39,6	2,3	6,2*	41,2	1,6	4,0*	6,1	17,4*
Running long jump, cm	1	351,6	380,3	28,7	8,2*	415,6	35,3	9,2*	449,1	33,5	8,1*	97,5	27,7*
	2	353,3	372,8	19,5	5,5*	395,1	22,3	6,0*	410,9	15,8	4,0	57,6	16,3*
Medicine ball throw (1 kg) from behind the head, cm	1	523,5	543,8	20,3	3,9	578,1	34,3	6,3*	631,8	53,7	9,3*	108,3	20,7*
	2	525,2	544,3	19,1	3,6	567,3	23,0	4,2*	612,6	45,3	8,0*	87,4	16,6*

*Note: * – the differences are statistically significant at $p<0,05$; 1 - going in for sports, 2 - non-sports people.*

The dynamics of results in the running long jump look somewhat different. Along with the annual increase in results from 11 to 12 years, there is a certain weakening of its growth in the period from 12 to 13 years, both among those involved in sports and those who did not engage in sports. Perhaps this is due to a decrease in the growth of speed abilities of boys in this age interval, and the result in the long jump is largely determined by the speed acquired by the athlete in the run-up. The overall increase in results in running long jumps over three years reached 97,5 cm (27,7%) for those involved in athletics and 57,5 cm (16,3%) for non-athletes. It can be assumed that the impact of training load in this test is 11,4%. In this case, one should take into account the fact that the result in running long jumps also depends on the technical preparedness of the athletes.

The total increase in the result in throwing a medicine ball among boys from 10 to 13 years old was 20,7% for young athletes and 16,6% for their peers. There is an insignificant role of training in this test - 4,1%. At the same time, at the age of 12-13 years, the greatest increase in results was found, which is explained by the sensitive period of increasing the strength capabilities of the muscles of the upper extremities [3, 4].

It must be emphasized that, despite the fact that Chinese schoolchildren participated in the survey, the composition of the subjects in no way influenced the results of the survey of a similar age group of children. Thus, research data obtained more than 40 years ago [4] conducted on schoolchildren showed that the most favorable age period for the development of speed abilities in boys is 9-11 years. Results similar to ours are also given in publications from the beginning of this century [1, 7]. This indicates that, regardless of national and temporal factors, sensitive periods for the development of speed and speed-strength abilities remain constant.

Thus, it can be stated that knowledge and consideration of sensitive periods - time ranges that are most favorable for the development of a particular human function or ability - contributes to the effectiveness of educational and training sessions with schoolchildren, since these are periods of decreased genetic control and increased sensitivity of the body to environmental factors. influences, including pedagogical and training [3, 6].

Conclusions. Data from a longitudinal study of speed and speed-strength indicators in young track and field athletes (10-13 years old) and children not involved in sports revealed statistically significant (for a 5% significance level) changes in them over a three-year period, which made it possible to specify changes in these indicators , determined not only by age-related growth in muscle strength, but also by training influences. The latter confirms the working hypothesis that an additional and targeted volume of physical activity for children of different school ages contributes to a more rapid acquisition of the required level of physical fitness, and priority stimulation of motor abilities that are in the stage of accelerated age-related development leads to significant shifts in the development of the latter. Moreover, as the skill of a young athlete grows, the organization of training influences in its focus should correspond to the mode of activity of his musculoskeletal system in the main specialized exercise [2].

References

1. Volkov L.V. Teoriya i metodika detskogo i yunosheskogo sporta. K.: Olimpiyskaya literature publ., 2002. 294 p.
2. Vrublevskiy E.P., Khorshid A.Kh., Albarkayi D.A. Vliyaniye napravlennosti treniruyushchikh vozdeystviy na rost sily myshts yunykh begunov na korotkiye distantsii. Teoriya i praktika fizicheskoy kultury. 2019. No. 4 (970). pp. 3–5.
3. Guba V.P., Bulykina L.V., Achkasov E.E., Bezuglov E.N. Sensitivnyye periody razvitiya detey. Opredeleniye sportivnogo talanta: monografiya. M.: Sport publ., 2021. 176 p.
4. Guzhalovskiy A.A. Razvitiye dvigatelnykh kachestv u shkolnikov. Mn.: Narodnaya asveta publ., 1978. 88 p.
5. Sergiyenko L.P. Sportivnyy otbor: teoriya i praktika: monografiya. M.: Sovetskiy sport publ., 2013. 1048 p.
6. Solodkov A.S., Sologub E.B. Fiziologiya cheloveka. Obshchaya. Sportivnaya. Vozrastnaya. Textbook. 5th ed., corr., sup. M.: Sport publ., 2015. 620 p.
7. Wychowański M. Wybrane metody oceny dynamiki układu ruchu człowieka. Warszawa: AWF, publ., 2008. 209 p.

Review of sport injures for teams and athletes

UDC 796 + 06

PhD, Associate Professor **T.A. Zenkova**[1]
PhD, Associate Professor **S.A. Shengelaya**[2]
PhD, Associate Professor **I.V. Groshevikhin**[2]
S.Yu. Chabovskiy[3]
[1]Rostov State Transport University, Rostov-on-Don
[2]The Academy of Physical Culture and Sport of the Southern Federal University, Rostov-on-Don
[3]Don State Technical University, Rostov-on-Don

Corresponding author: zata-70@mail.ru

Received by the editorial office on 20.05.2024

Abstract

Objective of the research was to analyses the causes and conduct a comparative analysis of the causes and consequences and the incidence of injuries for sport teams and athletes.

Methods and structure of the study. The athletes' sports activities were analyzed based on parameters such as volume, intensity, and number of competitions, as well as the nature and intensity of sports injuries. The experiment involved 150 student athletes from the technical school of the Rostov State University of Railway Engineering. The athletes' sports activities were analyzed based on parameters such as volume, intensity, and number of competitions, as well as the nature and intensity of sports injuries. The sports disciplines presented included track and field, swimming, judo, table tennis, basketball, football, and volleyball.

Results and conclusions. It was found that the injury rate was significantly higher in team sports compared to individual sports (62% in team sports, 38% in individual sports). Based on the number of injuries sustained during competitions and training activities, it was concluded that team sports athletes have a higher injury rate – 2,6 persons/injuries versus 1,7 persons/injuries in individual sports. Participation in team sports is associated with a higher risk of injury regardless of the intensity of the load.

Keywords: *incidence of injuries, sports injuries, sport teams, training, injury characteristics, students, competitions.*

Introduction. Physical activity of the younger generation is widely promoted all over the world due to its positive impact on the physical and mental development of the body. In the process of training and competitive activities, overfatigue and overtraining may occur as potential factors that can lead to sports injuries. The results of studies by specialists in this field V.O. Agranovich, E.V. Filippova show that injuries from overfatigue are largely associated with a large number of training sessions during the previous two days compared to sports injuries [1, 2]. The type of sport is an additional component of the risk of injuries associated with training. A number of studies show that the nature and intensity of injuries varies depending on the type of sport. Researchers note that the most serious injuries are received by athletes in team sports such as basketball and football [3].

Objective of the research was to analyses the causes and conduct a comparative analysis of the causes and consequences and the incidence of injuries for sport teams and athletes.

Methods and structure of the study. The experiment involved 150 student athletes from the technical school of the Rostov State Transport University, each of whom was observed for two academic years from 2021 to 2023. The age of the participants was 15-19 years. The observation period was 25 weeks in each academic year, two days a week, which amounted to 100 training and competition days organized throughout the academic process, from late September to early June of two academic years.

The study analyzed the athletes' sports activities according to such parameters as the volume, intensity and number of competitions, as well as the nature and intensity of sports injuries. The sports disciplines presented included athletics, swimming, judo, table tennis, basketball, football and volleyball.

Personal data - age, gender, sports activities and history of injuries over the past three years before the

study were collected using a questionnaire. In case of injuries, athletes were asked to put a mark in the sports diary on the day of the injury. A sports injury was functionally defined as a physical complaint that forces an athlete to interrupt or modify their usual sports activity for at least one training session. Injury characteristics were collected using a standardized questionnaire completed directly by the athlete. In addition, injuries were divided into overuse injuries (microtraumas caused by chronic overuse without a single identifiable cause) and traumatic injuries. Injury severity was defined based on days of absence from training as mild (0-3 days), minor (4-7 days), moderate (8-28 days), or severe (>28 days). Total sports activity was calculated separately for training and competition. If several competitions were held on the same day, such as a game tournament or disciplines with different heats, they were considered as one competition. Injury incidence was calculated as the number of injuries per 100 days of exposure. All data are presented as percentages or mean results. Comparisons of characteristics related to participation in sports competitions between team and individual sports were made using independent samples t-test. Significance was accepted at $p<0,05$.

Results of the study and discussion. The study revealed that 60% of student-athletes are involved in team sports. During the observation of sports activities, it was found that 54% of athletes were injured at least once. A total of 92 injuries were recorded, of which 62% occurred in team sports. In individual sports, the distribution of injuries by anatomical factor differed significantly ($p<0,001$), with a higher proportion of lower limb injuries and a lower proportion of upper limb and head and neck injuries (Table 1). No differences were found between team and individual sports in the distribution of injury types ($p=0,34$), severity ($p=0,18$), and categories ($p=0,25$).

Distribution of those involved in team sports: volleyball – 35%, basketball – 36%, football – 29%. In individual sports, the distribution of those involved showed: track and field – 31%, swimming – 27%, judo – 22%, table tennis – 20%.

The characteristics of sports activities of athletes in team and individual sports are presented in the figure, table 2.

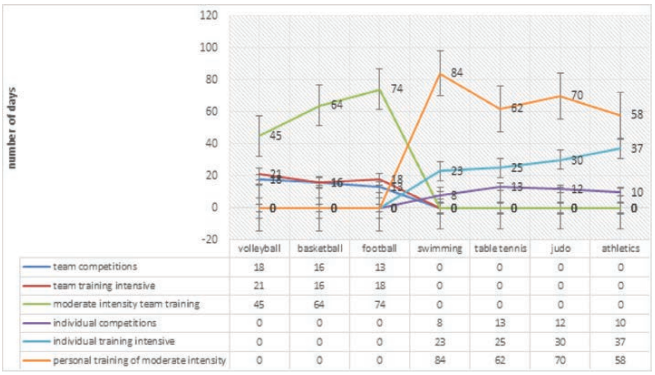
In team sports, the number of competitions per 100 days was significantly higher than in individual sports, and the number of intensive training sessions per 100 days was lower. The rates of injuries sustained during sports training activities are expressed as average values and were noted before the first injury and after the end of the study period.

Table 1. Characteristics of injuries in team and individual sports

Characteristics of injury	Team sports (57 people) Number (%)	Individual sports (35 people) Number (%)
Place of injury		
Upper limb	7 (12,3%)	8 (22,8%)
Lower limb	44 (77,2%)	21 (60%)
Torso	5 (8,7%)	5 (14,3%)
Head-neck	1 (1,8%)	1 (2,9%)
Type of injury		
Muscles and tendons	20 (35,1%)	15 (42,9%)
Capsules and ligaments	15 (26,3%)	8 (22,8%)
Bone fracture or other injury	9 (15,8%)	6 (17,1%)
Concussion	10 (17,5%)	4 (11,4%)
Nervous system	1 (1,8%)	1 (2,9%)
Other injuries	2 (3,5%)	1 (2,9%)
Severity of injury		
Mild (0-3 days)	19 (33,3%)	10 (28,6%)
Minor (4-7 days)	13 (22,9%)	9 (25,7%)
Moderate (8-28 days)	17 (29,8%)	9 (25,7%)
Severe (>28 days)	8 (14%)	7 (20%)
Injury category		
Traumatic	41 (71,9%)	25 (71,4%)
Overwork injury	16 (28,1%)	10 (28,6%)

Table 2. Indicators of competitive and training activity (average value in team and individual sports)

Competitions and types of training	Team sports	Individual sports
Number of competitions	15,66	10,75
Number of intensive training sessions	18,33	28,75
Number of moderate-intensity training sessions	61,00	68,50



Distribution of competitions and training intensity by sport

Having determined the average indicators of competitions in team and individual sports, it was found that the injury rate during one competition day was 3,7 persons/injuries and 3,3 persons/injuries, respectively. Further, when conducting intensive training loads, the number of injured people per training session was 3,1 persons/injuries in team sports, while in individual sports the figure was 1,2 persons/injuries. When analyzing the training process of moderate intensity, the number of injuries per training unit was 0,9 persons/injuries in team sports and 0,6 persons/injuries in individual sports.

Thus, taking into account the average indicators of competitive and training activities, we obtain the result that the injury rate in team sports was 7,7 persons/injuries versus 5,1 persons/injuries in individual sports. And the overall injury rate in team and individual sports is 2,6 and 1,7 persons/injury, respectively.

Conclusions. Team sports players have significantly more injuries than individual sports players, which confirmed our assumption. Significant differences in team and individual sports are reflected in the indicator characterizing the ratio of the number of competitions to the intensity of athletes' injuries in the general characteristics of sports, games and training activities (Table 2).

The results show that team sports are more likely to have traumatic illnesses and are characterized by injuries from overexertion. This aspect is due to the fact that these sports involve more game contacts, and the player's role in the team depends on many factors of social interaction. Moreover, a team athlete trains in a dynamic and rapidly changing environment, in which a high frequency of jumps, accelerations and turns can create high loads on the musculoskeletal system and, thus, contribute to injuries.

Playing a greater number of matches increases an athlete's susceptibility to the influence of this factor, which increases the risk of injury due to high physical loads, shorter recovery time after competitions and training. In individual sports, the planning and organization of the training process is developed individually for each athlete at the pre-competition stage, which reduces the risk of a negative reaction of the body to physical activity.

References

1. Agranovich V.O., Agranovich N.V. Analiz sportivnogo travmatizma pri zanyatiyakh fizicheskoy kulturoy i sportom i sozdaniye usloviy po yego snizheniyu. Mediko-farmatsevticheskiy zhurnal «Puls». Zdorovye i obrazovaniye v XXI veke. 2017. No. 2. Vol. 19. pp. 77-81.
2. Filippova E.V. K voprosu o bezopasnosti na zanyatiyakh fizicheskoy kulturoy v vuze. Trudy Rostovskogo gosudarstvennogo universiteta putey soobshcheniya. 2021. No. 2 (55). pp. 130-133.
3. Yasyukevich A.S., Gulevich N.P., Mukha P.G. Analiz urovnya i struktury sluchayev sportivnogo travmatizma v otdelnykh vidakh sporta. Prikladnaya sportivnaya nauka. 2016. No. 1 (3). pp. 89- 98.

The effect of cold on performance and muscle damage during intensive training

UDC 796.431.3

Dr. Med., Professor **L.V. Kapilevich**[1]
Postgraduate student **Ya. Wang**[1]
Postgraduate student **T. Li**[1]
E.S. Negodenko[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: kapil@yandex.ru

Received by the editorial office on 04.07.2024

Abstract

Objective of the study was to assessing the effects of cold immersion on muscle damage and performance during intense training.

Methods and structure of the study. A meta-analysis of publications was performed on the problem of using cold immersion for the purpose of recovery after physical activity. Using the keyword cold water immersion, 2,650 articles were found over the past 20 years, and when adding the words sport and/or exercise, 703 results were found. 120 articles with the highest citation index were selected based on the five-year period after the article was published.

Results and conclusions. Most of the work indicates the positive effects of cold immersion on recovery processes after intense physical activity. At the same time, positive effects are recorded mainly when using a temperature not lower than 10-15 ° C and a duration of over 15 minutes (or two short sessions with a small interval) and appear within the first day. Refrigeration at lower temperatures must be used with caution. It is also not recommended to exercise during the first hours after the cold immersion procedure.

Keywords: *recovery, cold immersion, exercise, muscle injury, performance*

Introduction. Exercise-induced muscle damage is a common consequence of intense exercise, which may require several days for muscle recovery to reach its baseline state [12]. Following a series of damaging exercises, muscle tissue regeneration depends on the inflammatory response [15], but an excessive response delays the regenerative process [15, 16]. Therefore, strategies aimed at optimizing the inflammatory response may be beneficial for the regenerative process and may ultimately accelerate muscle recovery. In this regard, cold water immersion (CWI) is a popular recovery method. However, data on its effect on muscle function recovery remain controversial. In addition, Tipton M.J. et al. [14] convincingly demonstrated in their fundamental review the contradictory effects of cold immersion, which can be significantly negative and even lead to death.

Objective of the study was to assessing the effects of cold immersion on muscle damage and performance during intense training.

Methods and structure of the study. A meta-analysis of publications on the problem of using cold immersion for recovery after physical exercise was performed. The keyword cold water immersion yielded 2650 articles over the past 20 years, and 703 results were found when adding the words sport and/or exercise. 120 articles with the highest citation index were selected based on the five-year period after the article was published.

Results of the study and discussion. The authors evaluate the effects of CWI using several groups of criteria. Most often, they evaluate based on the restoration of motor skills (running speed, jump height). The presence of pain is also evaluated. A number of authors use immunological and biochemical criteria to evaluate inflammation and metabolism. Some studies evaluated the state of neuromuscular interaction, complex coordination movements, and heart rate variability. Running was most often used as a load, sometimes in combination with jumping. In a number of

studies, studies were conducted on team sports players (football, rugby) after a match. The effects were most often evaluated within 24 hours, although there were also studies with a retrospective of up to three days. Of the 120 articles analyzed, 80 studies indicated positive effects of CWI for the recovery of athletes, 32 studies indicated no effect or minor negative effects, and 8 studies indicated inconsistency of the results obtained.

Vieira et al. [15] studied the effects of cold water immersion at 5 and 15°C on recovery from exercise-induced muscle damage. After training, subjects in the cold water immersion groups immersed their lower limbs in cold water for 20 minutes. Knee extensor isometric torque, counter-propulsion jump, muscle soreness, and creatine kinase levels were measured before, immediately after, 24, 48, 72, 96, and 168 hours after training. There were no differences between groups in isometric strength recovery (p=0,73). However, counter-propulsion jump recovery was faster in the cold water immersion groups compared to the control group (p<0,05). The counter-movement jump returned to baseline at 72 hours at 15°C, the 5°C group recovered at 96 hours, and the control group did not. Additionally, creatine kinase returned to baseline at 72 hours in the 15°C group, while it remained elevated at 168 hours in both the 5°C and control groups. At 24 hours post-exercise, there was a trend toward decreased muscle soreness (p=0,06) in the 15°C group compared to control.

A number of studies have shown similar results - partial immersion in water with a temperature of 10-15 degrees had an optimal effect for 1-2 days on the restoration of motor functions [1, 2, 10]; reduction of pain [1, 2, 6]; inflammation indicators [2, 11]; creatine kinase content in muscles [1]; heart rate variability [3].

The work [7] showed that in rugby players after performing a special exercise protocol (40 minutes) followed by immersion in cold water (8,9 ± 0,6 ° C; 9 minutes with 1 minute out of water, repeated twice). The results of the test with a continuous jump for 30 seconds immediately decreased, but increased 12 hours after immersion in cold water compared to the control. In studies where positive effects of CWI on the recovery process were absent, single immersion of less than 10 minutes duration and water temperature below 10°C were predominantly used. Thus, in study [9], under such conditions, there were no changes in plasma creatine kinase activity, sensations of soreness, and the strength of maximum voluntary contraction of the quadriceps femoris after CWI. In study [8], repeated CWI was used three times every 24 hours after exercise. In this case, maximum voluntary contraction of the knee extensors, creatine kinase activity, muscle soreness, range of motion, and limb girth did not differ between the experimental and control groups. In study [13], no effects of CWI on neuromuscular transmission parameters were found.

The position of a person during passive recovery
Note – on the left – full immersion in water (TWI), on the right – being in a room (CON)

It is also worth noting that in the work [10], along with the positive effects of CWI, they simultaneously note a decrease in the stiffness of the ankle joint, which increases the risk of injury. In addition, the need for a cautious approach to the use of cooling for the recovery of athletes is indirectly evidenced by works that showed that preliminary cooling negatively affected speed-strength qualities, agility, and also increased the risk of injury [4, 5].

Conclusions. To summarize the above, the following can be noted: most studies indicate positive effects of cold immersion on recovery processes after intense physical activity. Moreover, these effects are manifested both at the level of subjective omissions, and in the effectiveness of motor actions and in physiological indicators.

At the same time, positive effects are recorded mainly when using a temperature of at least 10-15°C and a duration of over 15 minutes (or two short sessions with a short interval) and appear within the first day.

Cooling with lower temperatures should be used with caution. Physical activity is also not recommended during the first hours after the CWI procedure.

The study was carried out with the support of the Development Program of Tomsk State University (Priority-2030).

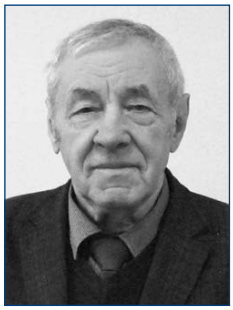
References

1. Abaidia A.E., Lamblin J., Delecroix B., Leduc C., McCall A., Nedelec M., Dawson B., Baquet G., Dupont G. Recovery From Exercise-Induced Muscle Damage: Cold-Water Immersion Versus Whole-Body Cryotherapy. Int J Sports Physiol Perform. 2017 Mar;12(3):402-409.
2. Ahokas E.K., Ihalainen J.K., Kyrolainen H., Mero A.A. Effects of Water Immersion Methods on Postexercise Recovery of Physical and Mental

Performance. J Strength Cond Res. 2019 Jun; 33 (6):1488-1495.
3. Almeida A.C., Machado A.F., Albuquerque M.C., Netto L.M., Vanderlei F.M., Vanderlei L.C., Junior J.N., Pastre C.M. The effects of cold water immersion with different dosages (duration and temperature variations) on heart rate variability post-exercise recovery: A randomized controlled trial. J Sci Med Sport. 2016 Aug;19(8):676-81.
4. Carlson L.A., Fowler C., Lawrence M.A. Agility and Vertical Jump Performances Are Impacted by Acute Cool Exposure. J Strength Cond Res. 2019 Jun;33(6):1648-1652.
5. Duffield R., Bird S.P., Ballard R.J. Field-based pre-cooling for on-court tennis conditioning training in the heat. J Sports Sci Med. 2011 Jun 1;10(2):376-84.
6. Elias G.P., Varley M.C., Wyckelsma V.L., McKenna M.J., Minahan C.L., Aughey R.J. Effects of water immersion on posttraining recovery in Australian footballers. Int J Sports Physiol Perform. 2012 Dec;7(4):357-66.
7. Garcia C.A., da Mota G.R., Marocolo M. Cold Water Immersion is Acutely Detrimental but Increases Performance Post-12h in Rugby Players. Int J Sports Med. 2016 Jul;37(8):619-24.
8. Goodall S., Howatson G. The effects of multiple cold water immersions on indices of muscle damage. J Sports Sci Med. 2008 Jun 1;7(2):235- 41.
9. Jakeman J.R., Macrae R., Eston R. A single 10-min bout of cold-water immersion therapy after strenuous plyometric exercise has no beneficial effect on recovery from the symptoms of exercise-induced muscle damage. Ergonomics. 2009 Apr;52(4):456-60.
10. Kositsky A., Avela J. The Effects of Cold Water Immersion on the Recovery of Drop Jump Performance and Mechanics: A Pilot Study in Under-20 Soccer Players. Front Sports Act Living. 2020 Mar 31;2:17.
11. Nunes R.Fh., Duffield R., Nakamura F.Y., Bezerra E.S., Sakugawa R.L., Loturco I., Bobinski F., Martins D.F., Guglielmo LG.A. Recovery following Rugby Union matches: effects of cold water immersion on markers of fatigue and damage. Appl Physiol Nutr Metab. 2019 May;44(5):546-556.
12. Paulsen G., Mikkelsen U.R., Raastad T., Peake J.M. Leucocytes, cytokines and satellite cells: what role do they play in muscle damage and regeneration following eccentric exercise?. Exerc Immunol Rev 2012; 18: 42-97
13. Sanchez-Urena B., Rojas-Valverde D., Gutierrez-Vargas R. Effectiveness of Two Cold Water Immersion Protocols on Neuromuscular Function Recovery: A Tensiomyography Study. Front Physiol. 2018 Jun 26;9:766.
14. Tipton M.J., Collier N., Massey H., Corbett J., Harper M. Cold water immersion: kill or cure? Exp Physiol. 2017 Nov 1;102(11):1335-1355.
15. Vieira A., Siqueira A.F., Ferreira-Junior J.B., do Carmo J., Durigan J.L., Blazevich A., Bottaro M. The Effect of Water Temperature during Cold-Water Immersion on Recovery from Exercise-Induced Muscle Damage. Int J Sports Med. 2016 Nov; 37(12):937-943.
16. White G.E., Rhind S.G., Wells G.D. The effect of various cold-water immersion protocols on exercise-induced inflammatory response and functional recovery from high-intensity sprint exercise. Eur J Appl Physiol 2014; 114: 2353-2367.

Foot health: new approaches to prevention in young athletes

UDC 614.8; 796.071.424.2



PhD, Associate Professor **V.F. Lutkov**[1]
PhD, Associate Professor **G.I. Smirnov**[1]
PhD, Associate Professor **D.I. Shadrin**[1]
PhD, Associate Professor **L.L. Miller**[1]
[1]Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg

Corresponding author: v.lutkov@lesgaft.spb.ru

Received by the editorial office on 27.06.2024

Abstract

Objective of the study was to creation of a multifaceted approach to prevent and treat foot arch problems in young athletes engaged in team sports.

Methods and structure of the study. Plantography methods, Romberg test, and mathematical statistics method (Microsoft Office Excel and Stats Graphics) were used. The objects of the study were young football players aged 9-10 years old from the Junior football school and volleyball players aged 12-13 years from the Ekran school and Nevskie Zvezda school. There are 36 young athletes in total.

Results and conclusions. It has been confirmed that to effectively prevent and treat foot problems in young athletes engaged in sports, it is crucial to identify potential risk factors. The primary risk factor for foot arch disorders is the impact forces experienced when the foot contacts the ground during running and jumping, which exceed the adaptive capacity of the foot's connective tissues, muscles, and bones. Muscle weakness and compromised ligament and tendon elasticity can result in flat feet, leading to various types of lower limb overuse injuries in young athletes. To prevent the development of foot arch pathology, a comprehensive exercise program has been developed, which includes: 1) exercises without weight-bearing on the feet; 2) exercises with weight-bearing on the feet; 3) exercises for the feet using objects.. Through a comparative examination of the evolution of the degree of foot arch impairment following the implementation of the devised exercise regimen, it was determined that there was a positive trend: a reduction in the severity of flat feet was observed in 54.7% of football players and 97.5% of volleyball players.

Keywords: *young athletes, arches of the feet, flat feet, new methods of prevention, game sports*

Introduction. One of the most pressing issues in modern sports is the prevention and rehabilitation of injuries and diseases of the musculoskeletal system (MSS) in athletes. They are caused by a complex of risk factors, including external, internal and specific to a particular sport [4, 7, 8].

One of the types of chronic MSS overstrain in young athletes is foot arch pathology, which is observed in 55,9% of various team sports [6]. The main risk factor in young athletes is the biological patterns of connective tissue formation and force impact loads of the foot with support during running and jumping [5]. Such excessive impact loads lead to weakening of the foot muscles, joint instability and, as a consequence, to flat feet.

It should be noted that the motor homeostasis of a growing organism is characterized by ontogenetic patterns of formation of all physiological qualities that must be taken into account in the training process of children [6, 9]. The development of prevention and rehabilitation of diseases in athletes should be based on the achievements of modern theoretical and practical medicine, offering new approaches, methods and means.

One of such areas is integrative medicine [3], which provides for the synthesis of scientific, allopathic and holistic models of diagnosis and treatment. The main principle of integrative medicine is to increase the adaptive and compensatory capabilities of the patient's body, eliminating risk factors.

In addition to integrative medicine, the choice of means and methods for the prevention and rehabilitation of chronic overstrain of the musculoskeletal system in athletes is influenced by the basic provisions of connective tissue medicine [1]. This is due to the fact that connective tissue in the body unites all life support systems and implements the process of adaptation of the body to the environment.

The purpose of the adaptive role of connective tissue at different intensity of the training process in children and adolescents is indicated by the results of the study of V.I. Nechaev and T.M. Nikitin. Thus, with not "mature" arches of the foot, with a decrease in the reserve of elastic properties of arch-forming tissues, excessive training load leads to flattening of the arches of the foot. In their opinion, blind copying of the volume of training loads of adult athletes leads to flattening of the arches of the foot and the formation of functional weakness of the foot. As a result, the foundations of functional insufficiency of the feet of athletes are laid in childhood and adolescence, persist for life and require secondary prevention throughout the entire period of sports [2].

Objective of the study was to creation of a multifaceted approach to prevent and treat foot arch problems in young athletes engaged in team sports.

Methods and structure of the study. The study involved 20 young football players aged 9-10 years (10 boys made up the control group and 10 boys – the experimental group) at the Junior Football School, a branch of DSI Zenit, 16 female volleyball players aged 12-13 years, at the Ekran Sports School of the Vyborg District of St. Petersburg, and also at the Nevskie Zvezdy Sports School of the Olympic Reserve. Eight girls made up the control group and eight girls – the experimental group. The following methods were used: Romberg tests (placing the feet on one line, with the heel of one foot touching the toe of the other - 24-28 seconds (according to A.F. Sinyakov), assessment of the arches of the feet (plantograms were processed using the methods of V.A. Shtriter, I.M. Chizhin) [6], statistical data processing. At the first stage, the arches of the feet were assessed, Romberg tests were performed. Exercise sets were developed. At the second stage, exercises were carried out in training sessions and it was recommended to perform the exercises at home (3-4 times a week). Three exercise sets were developed including: 1) exercises without axial load on the feet; 2) exercises with axial load on the feet; 3) exercises for the feet with objects. At the third stage, the arches of the feet, Romberg tests were re-evaluated and the results obtained were analyzed (Student's t-criterion).

Results of the study and discussion. In order to achieve the set goal, a dynamic study of the arches of the feet, the Romberg test in young athletes of team sports was conducted. The results of plantography (the norm is 43-50 units) showed that most young football players have deviations in the development of the arches of the foot 55,92 ± 3,7% at the beginning of the study. In addition, various violations are determined on the right and left legs 15% (Figure 1), 25% have longitudinal flat feet of both feet, 40% have transverse flat feet, 30% have hollow feet, 25% have no deviations.

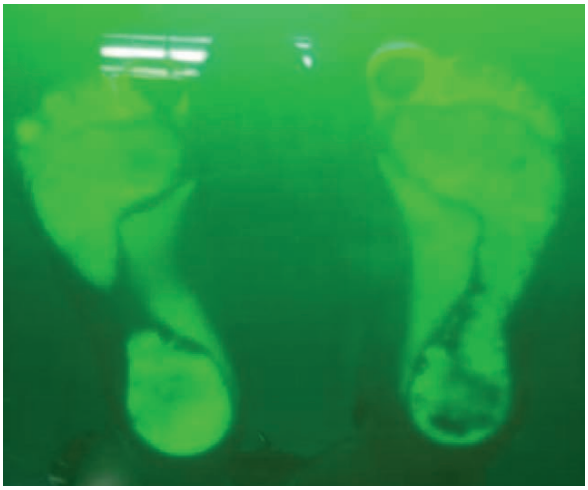


Figure 1. Different heights of the longitudinal arch and transverse flat feet

After using the proposed complex, at the end of the observations, improvements of 54,69±3,39 ($p \geq 0,05$) were revealed. The results of the Romberg test indicate poor static coordination of young football players (8,55±4,68 s). After repeating the Romberg test, the results improved (11,65±4,16 with $p \geq 0,05$) (Figure 2).

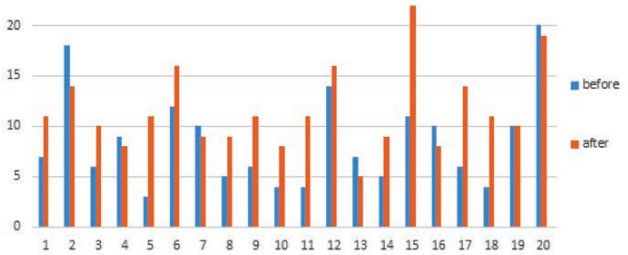


Figure 2. Comparison of Romberg test results in young football players

Table 1. Indicators of the Plantogram test in the experimental group (%)

Research stage		N	$\bar{x} \pm S\bar{x}$	Meaning p-value	p
Left leg	Before the experiment	8	1,7125±0,173	0,000480734	<0,05
	After the experiment	8	1,173±0,199		
Right leg	Before the experiment	8	1,7125±0,212	0,00010255	<0,05
	After the experiment	8	1,172±0,201		

Table 2. Indicators of the Plantogram test in the control group (%)

Research stage		N	$\bar{x} \pm S\bar{x}$	Meaning p-value	p
Left leg	Before the experiment	8	1,8±0,7143	04497	>0,05
	After the experiment	8	1,7125±0,173		
Right leg	Before the experiment	8	1,825±0,175	04788	>0,05
	After the experiment	8	1,75±0,233		

Table 3. Indicators of the test «Heel pronation angle» (o)

Research stage		N	$\bar{x} \pm S\bar{x}$	Meaning p-value	p
Left leg	Before the experiment	8	12,0±2,0	0,000225759	<0,05
	After the experiment	8	5,375±1,408		
Right leg	Before the experiment	8	11,75±1,669	0,000121812	<0,05
	After the experiment	8	5,5±1,414		

Table 4. Indicators of test No. 2 «Heel pronation angle» (o)

Research stage		N	$\bar{x} \pm S\bar{x}$	Meaning p-value	p
Left leg	Before the experiment	8	14,25±1,98	0,6217	>0,05
	After the experiment	8	13,75±1,98		
Right leg	Before the experiment	8	13,875±1,885	0,145	>0,05
	After the experiment	8	12,63±1,3		

The results of Romberg tests are affected by the asymmetrical state of the feet. If one of the feet is significantly flattened compared to the other, this noticeably affects the ability to maintain balance in the complicated Romberg test. The inability to stand in a narrow stance indicates a significant imbalance due to flat feet. If the load is distributed incorrectly, valgus/varus tilt in the ankle joint, both in one foot and between the feet, discomfort occurs, which disrupts static coordination. The test results of volleyball players after the experiment on the Plantogram test in the experimental group are presented in Table 1.

The test results of volleyball players after the experiment on the Plantogram test in the control group are presented in Table 2.

According to the analysis of the results of Tables 1 and 2, it can be concluded that statistically significant changes in the Plantogram test occurred in the experimental group of volleyball players after the experiment. No statistically significant changes occurred in the control group. The results of the Heel Pronation Angle test in volleyball players were also subjected to mathematical and statistical processing. The results of the mathematical processing of the outcome of the experiment in the experimental group are presented in Table 3.

The results after the experiment on the “Heel Pronation Angle” test for volleyball players in the control group are presented in Table 4.

According to the analysis of the results of tables 3 and 4, it can be concluded that statistically significant changes in the «Heel Pronation Angle» test occurred in the experimental group of volleyball players after the pedagogical experiment. No sta-

tistically significant changes occurred in the control group.

Flat feet as an internal factor leads to a violation of the biomechanics of the lower limbs, and as a consequence, to pathological problems of the free lower limb and the lower limb girdle. The applied complex performs a preventive purpose, it brings the ankle joint to a physiological position, and thereby removes excess dynamic and static load from it, contributing to the improvement of the tone of the ligaments and muscles of the feet.

Analysis of the obtained results showed that the compiled training program is effective. Thus, the strength of the calf muscles increased, many of those involved improved balance and a sense of equilibrium, which indicates an improvement in the tone of the muscles and ligaments of the foot, ligaments of the calf. Of course, this complex should be performed on a regular basis or at least over a longer period of time, especially when it comes to exercises for the correct formation of the arches of the foot. Ligaments and tendons are bradytrophic tissues, and to improve their functional state and restore the physiological position of the feet, it is necessary to use preventive measures over a long period.

Conclusions. It has been established that flat feet are detected in young athletes of team sports. It is caused by excessive impact loads when the foot contacts the support when running and jumping. Such loads exceed the functional reserve of elastic properties of the arch-forming connective tissues of the foot, and as a result, lead to flattening of the feet. A program of secondary prevention of flat feet in young athletes has been developed. The means and methods of secondary prevention contributed to the reduction of flat feet in 57% of football players and 97,5% of volleyball players. Prevention of flat feet in young athletes should be considered as a system for preventing chronic syndromes of overexertion of the lower extremities and is carried out constantly during sports.

References

1. Alekseev A.A., Titov O.V. Soyedinitelnotkannaya biologiya i meditsina 21 veka na osnove vseobshchego zakona triyedinstva (noveyshiye teorii, lechebnyye skhemy, posledniye dostizheniya farmindustrii dlya otvetstvennykh rukovodyashchikh rabotnikov gosudarstva, promyshlennosti, meditsiny, farmakologii, vrachey, tseliteley, bolnykh). Moscow, 1997. 128 p.
2. Nechaev V.I., Nikitina T.M. Ploskostopiye, podrostki, sport. Meditsina i sport. 2006. No. 2. pp. 22-23.
3. Partsernyak S.A. Integrativnaya meditsina: put ot ideologii k metodologii zdravookhraneniya. A.V. Shabrova [ed.]. St. Petersburg. «Nordmedizdat» publ., 2007. 424 p.
4. Platonov V.N. Dvigatelnyye kachestva i fizicheskaya podgotovka sportsmenov. Moscow: Sport publ., 2022. 656 p.
5. Renstrem P.A.F.Kh. Sportivnaya travma. Kiyev: Olimpiyskaya literatura publ., 2003. 471 p.
6. Smirnov G.I., Shadrin D.I. Lechebnaya fizicheskaya kultura v travmatologii i ortopedii. Study guide. Natsionalnyy gosudarstvennyy universitet fizicheskoy kultury, sporta i zdorovya im. P.F. Lesgafta. St. Petersburg, 2014. 116 p.
7. Chashchin M.V., Konstantinov R.V. Professionalnyye zabolevaniya v sporte. Moscow: Sovetskiy Sport publ., 2010. 176 p.
8. Shoylev D. Sportivnaya travmatologiya. Meditsina i fizkultura, publ. Sofiya, 1986. 192 p.
9. Yankauskas Y.M., Logvinov E.M. Motorika rastushchego zhenskogo organizma. Vilnyus: Mokslas publ., 1984. 152 p.

The effectiveness of the training process of skiers using computer vision methods

UDC 796.012.37

PhD **N.B. Novikova**[1]
A.N. Novikov[2]
I.G. Ivanova[1]
A.N. Belyova[1]
[1]Saint-Petersburg scientific-research institute for physical culture, St. Petersburg
[2]ITMO University, St. Petersburg

Corresponding author: novik-nat@mail.ru

Received by the editorial office on 01.07.2024

Abstract

Objective of the study was to experimentally validate the use of computer vision techniques to enhance the efficiency of ski racing training management.

Methods and structure of the study. The examination of video footage of athletes gliding on roller skis at their top speed was conducted using a specially designed software that incorporates a motion-detection system for athletes, powered by the Alpha Pose neural network.

Results and conclusions. The advanced software enables precise identification of ski racers' movements in training and competition settings, providing visual representation of angular features and velocities in joints. Additionally, it can generate videograms automatically. The data obtained can be used to assess the effectiveness of skiing techniques and detect technical flaws that may go unnoticed using conventional methods.

Keywords: *highly skilled cross-country skiers, technical training, technique of simultaneous one-step skating, neural network, computer vision methods, scientific and methodological support, video analysis of sports movements*

Introduction. The performance of high-class cross-country skiers largely depends on the accuracy of training effects and timely control of physical and technical training. The main problems of pedagogical control in cross-country skiing are the lack of objective indicators of special training, due to the variability of the conditions of training and competitive activities and the lack of modern technologies and instrumental methods. One of the current areas of improving scientific and methodological support in cross-country skiing is the search for testing tools and methods that ensure rapid provision of objective and significant information to the coach, available for use in field conditions, not affecting the training process, fairly cheap and not requiring imported consumables. It was previously shown that the values of joint angles in key phases of the ski run depend on the effort exerted and change as a result of a controlled change in the intensity of movement or an unintentional decrease in speed due to fatigue, which allows using these indicators to assess the level of training in races and intensive training [1]. A significant drawback of biomechanical research methods is the labor intensity of video recording processing, since even in advanced video analysis programs, annotation of key points and measurement of most indicators is done manually. Currently, solutions for markerless motion capture are being developed using complex models of the human body, computer vision and machine learning algorithms [2]. Most often, optoelectronic marker systems are used for motion analysis, but their use outdoors is limited due to the uncontrolled impact of environmental factors, the presence of other people or insufficient lighting. Publications by German scientists describe the experience of developing programs for recognizing ski jump videos [3], however, in cross-country skiing, the measurement of kine-

matic characteristics from videos made by 2D cameras outdoors has so far been performed manually.

Objective of the study was to experimentally validate the use of computer vision techniques to enhance the efficiency of ski racing training management.

Methods and structure of the study. All measurements were performed in a specially created computer program[1], including a system for recognizing athletes' movements based on the Alpha Pose neural network, calculating the values of the required joint angles, and constructing graphs and cinograms. The video was filmed using a fixed Sony HDR-CX 730 EV video camera installed perpendicular to the direction of the athletes' movement.

The kinematic data were filtered using a smoothing function by averaging the values in a fixed-length window that moves through the data. The selection of points for angle measurements was performed according to traditional positions [1].

Results of the study and discussion. The developed computer program calculated the values of joint angles in the ankle, knee and hip joints in a continuous cycle of simultaneous one-step skating stroke of athletes of the Russian national team when moving at maximum speed on roller skis. The acceleration time on a gentle slope was 18-20 s. The measurements of the joint angle values were visualized in the form of graphs, examples of which are presented in figure 1.

The start of measurements corresponds to the moment of placing the poles, the decrease in the curves corresponds to squatting, the first rise of the curves (increase in the angles in the knee and hip joints) corresponds to pushing off. The second rise of the lines corresponds to the extension of the

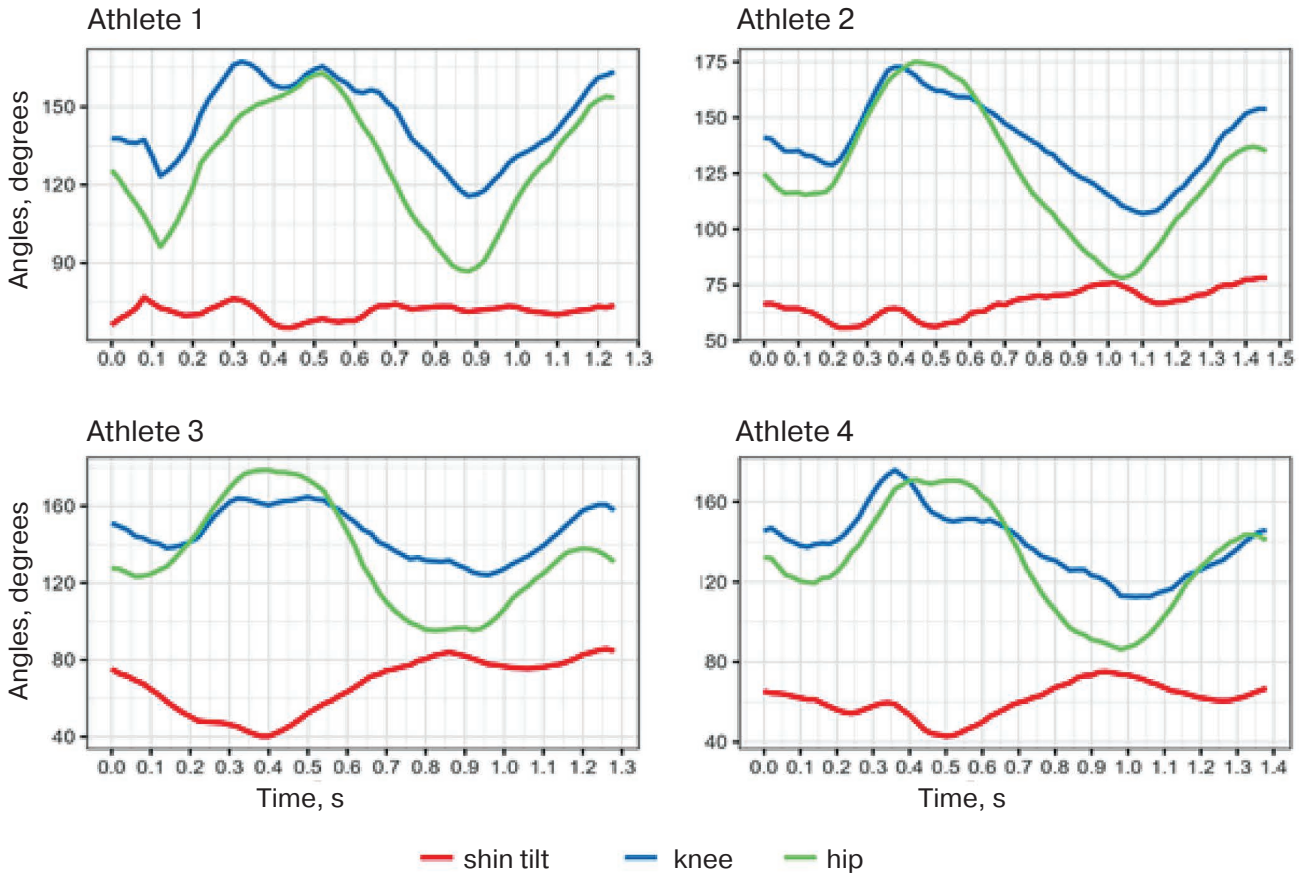


Figure 1. Examples of graphs of the dynamics of the angular characteristics of a simultaneous single-step stroke

[1]Certificate of state registration of the computer program "Program for automatic determination of biomechanical characteristics of skiing technique based on 2D video recordings" (SPbNIIFK. SKI-COMPUTER VISION) No. 2024668312 dated 06.08.2024.

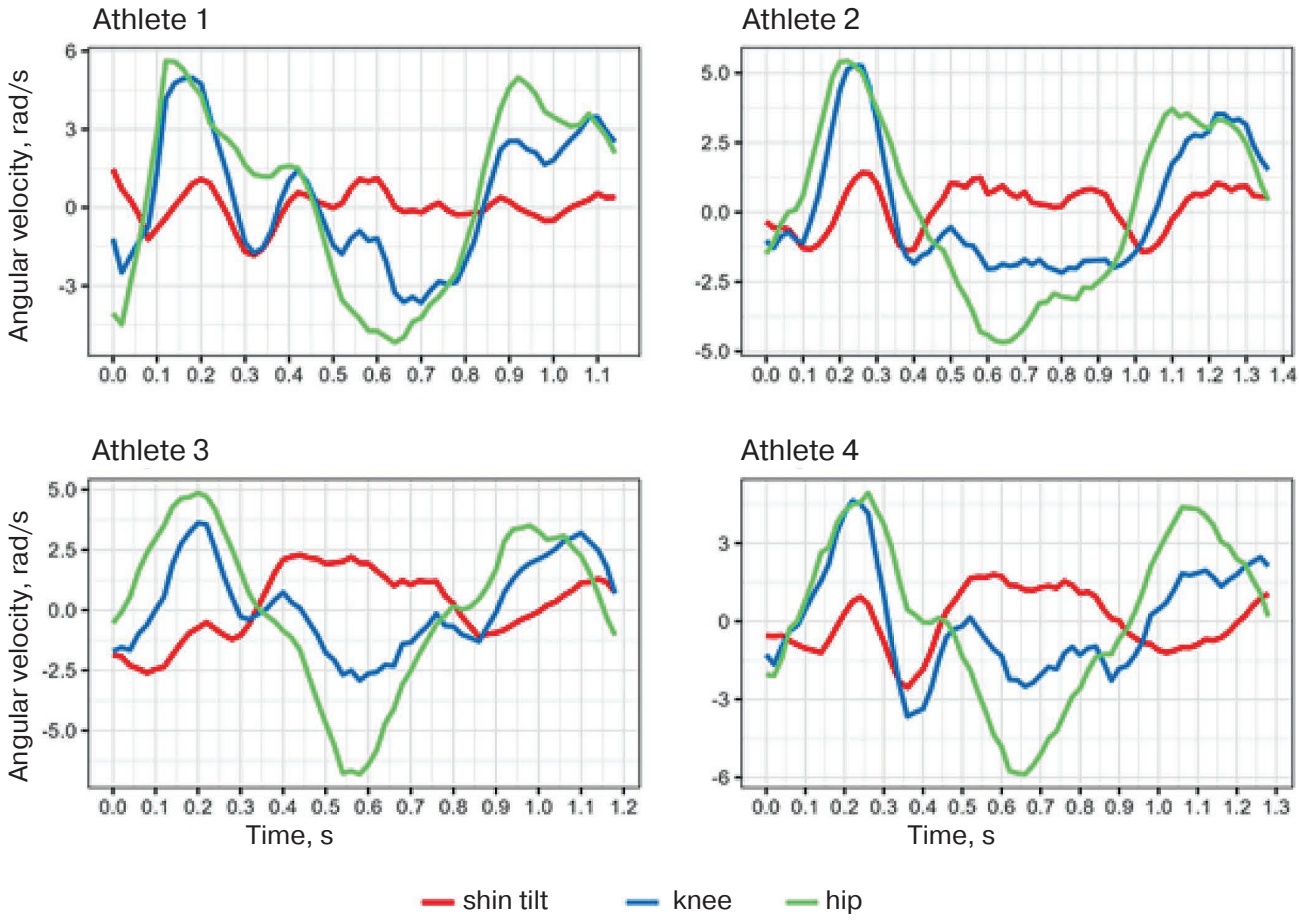


Figure 2. Examples of graphs of the dynamics of angular velocities of movement in joints in a simultaneous single-step movement

legs before the next placing of the poles. The resulting graphs allow us to evaluate the consistency and amplitude of movements in the joints, compare the duration of squatting and pushing off.

For example, athlete 3 demonstrates the beginning of leg flexion before placing the poles on the support - an error that often appears when moving at maximum speed, but is not detected when measuring angular characteristics only in key positions. The deepest squatting (decrease in the curve of the angle in the knee) is determined in athlete 1, however, the angle in the ankle joint increases (rise in the red line), which leads to a shift in the center of gravity back and can prevent the timely transfer of

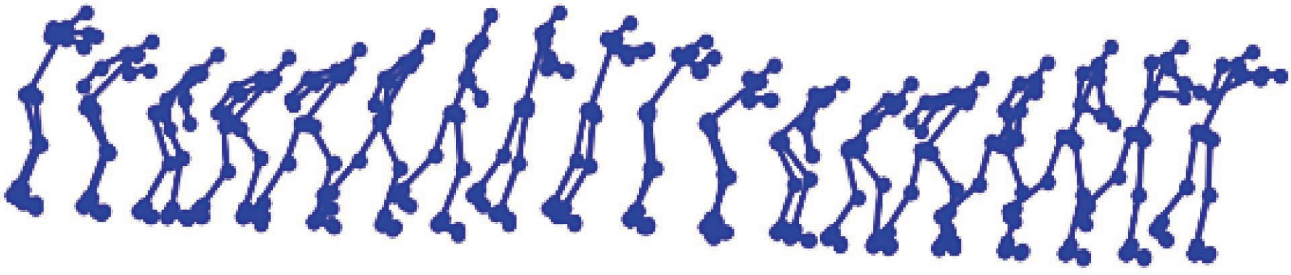


Figure 3. Example of a videogram of a simultaneous single-step stroke, performed in automatic mode

body weight. The efficiency of ski racing technique is determined not so much by the magnitude as by the precision and timeliness of the applied efforts with maximum use of the repulsion inertia in the sliding step. It is impossible to evaluate the real dynamic characteristics of the repulsion without interfering with the training process, but measuring continuous indicators of angular velocities of movement in the joints can provide significant information on the distribution of efforts (Figure 2).

The simultaneous increase in the knee and hip joint extension velocity in athletes 2 and 4 apparently indicates a high push-off efficiency due to the coordinated work of large muscle groups. The increase in angular velocity during the push-off of athlete 3 is expressed to a lesser extent. Further studies are needed to analyze the association of the angular velocity gradient of the push-off with the athlete's forward velocity. The discrepancy in the hip and knee joint extension velocities during the swing movement also requires attention and, possibly, correction.

Consideration of the dynamics of angular characteristics and angular velocities simultaneously with the analysis of kinograms (Figure 3) can provide a complete picture of the technical features of each athlete.

Conclusions. The developed computer program based on the application of the computer vision method allows with sufficient accuracy to recognize video recordings of cross-country skiers made in conditions of training and competitive activities, to visualize the dynamics of angular characteristics and angular velocities of movement in joints, and to build videograms in automatic mode. The obtained data allow to evaluate the efficiency of skiing technique and to identify technical errors that are difficult to notice when using traditional methods of technique analysis. The advantages of the method include reduced time and increased accuracy of measurements, the ability to process large amounts of data and automatic visualization of results. There are some limitations in using the developed computer program, for example, increased requirements for server and video card performance, Linux OS, the inability to recognize the movements of skiers moving in parallel in one video sequence. Further research is needed to improve the methodology for assessing technical preparedness using the developed program.

References

1. Novikova N.B., Ivanova I.G., Belyova A.N. Informativnost biomekhanicheskikh kriteriyev v otsenke sorevnovatelnoy effektivnosti lyzhnikov-gonshchikov vysokoy kvalifikatsii. Teoriya i praktika fizicheskoy kultury. 2024. No. 5. pp. 34-37.
2. Colyer S.L., Evans M., D.P. Cosker, Salo A. A Review of the Evolution of Vision-Based Motion Analysis and the Integration of Advanced Computer Vision Methods Towards Developing a Markerless System. Sports Med Open. 2018. Vol. 4. No 4 (1). 24 p.
3. Ludwig K. Lienhart R., Muller S., Kreibich S. Optimierung der voll automatischenzeit kontinuierlichen Erkennung der Korperpose und Skiposition von Skispringern in Videoaufnahmen. BISp-Jahrbuch Forschungs f rderung. 2021/22. pp. 361-364.

Optimization of physical education classes using artificial intelligence for students of SMG

UDC 796.01:004.8

Yu.A. Karvunis[1]
Associate Professor **Yu.G. Kalinnikova**[1]
N.A. Karvunis[1]
Dr. Med., Professor **L.V. Kapilevich**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: kapil@yandex.ru

Received by the editorial office on 04.07.2024

Abstract

Objective of the study was to exploration of the potential for employing artificial intelligence to tailor physical education lessons for students in a specialized medical group, and the evaluation of the impact of this approach on the educational experience within the university.

Methods and structure of the study. The research work was conducted in two distinct phases. In the initial phase, which commenced in early 2023, an AI-based model was created. This model was employed to evaluate physical abilities and create personalized physical education plans for students in a special medical group at the Tomsk State University. The model is based on a multimodal neural network, specifically Generative Pretrained Transformer 4o.

Results and conclusions. The potential of AI in tailoring physical education lessons for students with specific medical conditions has been explored, and the success of its implementation in the university's curriculum has been evaluated. The use of AI has been shown to be highly effective in personalizing lessons for students with special medical needs. By considering the unique characteristics of each student's illness and physical abilities, AI has helped to enhance physical performance, reduce the frequency of disease flare-ups, and increase student satisfaction with their lessons.

Keywords: *students, special medical group, physical education, artificial intelligence.*

Introduction. Physical education occupies a central place in the comprehensive rehabilitation of students with health problems [1, 2]. An individual approach to physical education classes for this category of students is most important, as it allows taking into account the specifics of their diseases, limitations and physical capabilities [3, 6].

Recently, artificial intelligence (AI) systems have been widely introduced into all areas of human activity, including physical education [5]. AI systems allow analyzing students' physical data, such as heart rate, speed and endurance, and some others, in order to quickly and efficiently create personalized training programs adapted to their individual needs and goals. AI can continuously monitor students' progress by analyzing their performance indicators and providing feedback in real time. AI can be used to analyze students' exercise technique and provide personalized instructions for their improvement [4].

Thus, the use of artificial intelligence has great potential for optimizing the process of individualization of physical education, including for students of a special medical group.

Objective of the study was to exploration of the potential for employing artificial intelligence to tailor physical education lessons for students in a specialized medical group, and the evaluation of the impact of this approach on the educational experience within the university.

Methods and structure of the study. The research was carried out in two main stages. At the first stage, in early 2023, a model for working with AI was developed, which was used to assess physical capabilities and draw up individual physical education les-

son plans for students of a special medical group at universities of the Big University of Tomsk.

The model was constructed based on the multimodal neural network Generative Pre-trained Transformer 4o (GPT-4o, OpenAI, USA). The following information about the student served as the initial indicators for building the model: gender, age, body weight, height, resting heart rate, resting blood pressure (systolic/diastolic), existing diagnoses (indicating the severity/stage of the disease). The system was trained by loading sets of individualized exercise therapy programs for various diseases into it, as well as by loading reviews of the program options proposed by the neural network. The formulation of queries to the neural network was processed using the method of repeated queries indicating the required frequency and duration of classes. The working version was implemented as a virtual assistant (chat bot), which, upon request with the input parameters, offered a version of the program of classes. At the same time, the final decision on the use of the results in practical activities was made by specialists to exclude the possibility of harm to the health of students.

At the second stage, an experimental study was conducted with the participation of 60 students of a special medical group. The students were divided into two groups: the experimental group (40 students), for which individual physical education lesson plans were used, compiled using the author's model of working with AI, and the control group (20 students), which continued physical education classes according to the standard scheme for a particular university.

The results and effects of using the model were assessed by the following indicators:

- Improvement in physical performance (strength, flexibility, coordination) indicators were recorded using dynamometry and flexibility and coordination tests (tilt from a standing position on a bench, static balance);
- Reduction in the frequency of exacerbations of diseases (recording of symptoms and absences due to illness);
- Increasing student satisfaction with physical education classes (survey).

Statistical data processing was carried out using the GraphPad Prism 9.3.1 program (academic license No. 1531155, valid until December 16, 2024).

Results of the study and discussion.

Improvement of physical performance

According to the results of the study, the experimental group showed a significant improvement in physical performance for all measured indicators (Table 1). Thus, strength increased by 15,3%, flexibility by 17,6%, coordination by 14,2%. In the control group, the improvement in physical performance was insignificant and did not reach statistical significance.

Reduction in the frequency of exacerbations of diseases

In the experimental group, a decrease in the frequency of exacerbations of diseases was observed (Table 2). Thus, the number of exacerbations of diseases per year decreased by 30%. In the control group, the decrease in the frequency of exacerbations of diseases was less pronounced and did not reach statistically significant indicators.

Increasing student satisfaction with physical education classes

The results of the study showed that the students in the experimental group were more satisfied with physical education classes compared to the students in the control group. Thus, the level of satisfaction with classes increased by 16% in the experimental group and by 8% in the control group. The students in the experimental group left positive emotionally charged reviews in the questionnaires, which will be further studied using the content analysis method.

The results of the study demonstrate the effectiveness of using AI to implement an individual approach to physical education classes for students in a special medical group. The use of AI made it possible to take into account the specifics of diseases and physical capabilities of each student, which contributed to improving physical performance, reducing the frequency of exacerbations of diseases and increasing student satisfaction with classes.

In our opinion, the use of AI in physical education opens up a number of opportunities for optimizing the educational process:

Table 1. Change in physical performance

Indicators	Increase in experimental group, %	Increase in control group, %
Strength	15,3	7,1
Flexibility	17,6	8,3
Coordination	14.2	6,4

Table 2. Change in the frequency of exacerbations of diseases

Groups	Number of exacerbations before the study	Number of exacerbations after the study
Experimental	1,2 ± 0.4	0.8 ± 0,3*
Control	1.3 ± 0.5	1.1 ±0.4

** – Significance of differences between groups, p<0,05.*

• Individualization of classes: AI will allow you to create personalized physical exercise programs adapted to the specific needs and limitations of each student.

• Taking into account the dynamics of health: AI models will allow you to track changes in students' health and make adjustments to physical education lesson plans.

• Progress monitoring: AI will help monitor students' progress and identify deviations from individual plans in a timely manner.

• Increased motivation: Personalized study programs and progress tracking can increase student motivation and make classes more interesting.

Conclusions. The use of artificial intelligence is a promising direction in the individualization of physical activities for students of a special medical group. The model of working with AI proposed in the study allows taking into account the specifics of diseases and physical capabilities of each student, which leads to improved physical performance, a decrease in the frequency of exacerbations of diseases and an increase in satisfaction with classes. The integration of AI into the educational process in physical education can significantly increase its effectiveness and become an important tool for maintaining the health and physical well-being of students with health problems.

The study was carried out with the support of the Development Program of Tomsk State University (Priority-2030).

References

1. Begidova T. P. Adaptivnaya fizicheskaya kultura v kompleksnoy reabilitatsii lits s otkloneniyami v sostoyanii zdorovya. Study guide for universities. Moscow: Yurayt publ., 2024. 210 p.
2. Vlasova V.P. Fizicheskaya reabilitatsiya studentov s ogranichennymi vozmozhnostyami zdorovya i invalidov v usloviyakh pedagogicheskogo vuza. Sovremennyye problemy nauki i obrazovaniya. 2018. No. 4. 207 p.
3. Gorelov A.A., Noskov M.S., Tretyakov A.A. et al. Individualizatsiya kak osnova povysheniya effektivnosti sportivnoy deyatelnosti. Sovremennyye problemy nauki i obrazovaniya. 2015. No. 1-2. 137 p.
4. Grigorenko D.V., Bakeshin K.P. Primeneniye iskusstvennogo intellekta v protsesse fizicheskoy podgotovki. Molodoy uchenyy. 2024. No. 15 (514). pp. 446-448.
5. Korovnikova N.A. Iskusstvennyy intellekt v sovremennom obrazovatelnom prostranstve: problemy i perspektivy. Sotsialnyye novatsii i sotsialnyye nauki. 2021. No. 2 (4). pp. 98-113.
6. Proshlyakov V.D., Nikitin A.S. Metody i sredstva diagnostiki v fizicheskom vospitanii i sporte studentov s otkloneniyami v sostoyanii zdorovya. Moscow: Eko-Vektor publ., 2015. 160 p.

The approach of incremental adjustment, guided by heart rate variability metrics, in the coaching of elite swimmers

UDC 796.922.093.1

D.A. Pankov
The Federal Training Sports Center of the representative teams of Russia, Moscow

Corresponding author: wimmings98@mail.ru

Received by the editorial office on 28.08.2024

Abstract

Objective of the study was to assess the effectiveness of the Varicard system in optimizing the training regimen for elite swimmers.

Methods and structure of the study. 30 qualified athletes took part in the observation: 10 masters of sports, 14 international masters of sports, 6 honored masters of sports. The task was to use HRV indicators in training management over a selected period, the same for the control and experimental groups. The study used the VARICARD complex and the ISCIM6 program.

Results and conclusions. The findings of the research demonstrated the success of the «sitting position» scenario in accordance with the outlined monitoring procedure. The significance of the data collected enables the creation of a more precise training program.

Keywords: *heart rate variability, stress index (SI), elite swimmers, microcycle, progress indicator.*

Introduction. Solving the problem of reliable interpretation of HRV indicators during training will allow achieving tangible progress in competitive activities [8, 12]. To assess the state of the regulatory systems of the athletes' body, it is important to have accessible and simple measurement methods. The main thing in these cases will be the dynamics of changes and the repetition of control measurements. In the analysis of HRV indicators, it is important to select digital indicators that will reliably correlate with each other [7]. On the way to a sports result, a balance is needed between additional resources of the body and the maintenance of natural homeostasis [8, 11].

To monitor the current state, it is necessary to use, including in different directions, various functional tests and make minor but important changes to the training program [9]. It is noted that, in general, for the most effective impact on strength endurance, as a developing quality, training should be built in aerobic zones. (V. S. Gorozhanin, 1984, Avdienko V. B., Solopov I. N., 2019, Avdienko V. B., 2021, V. M. Volkov, 1990). For correct reproduction of the research results, a similar qualification level of athletes, a number of measurements and suitable standard conditions are required [6]. The whole range of control measures will help to avoid premature intensification of the training process. (A. G. Dembo, 1980; P. P. Ozolin, 1984). It is necessary to create conditions for the realization of a high training potential. A higher training level is ensured on the basis of a high level of development of aerobic endurance (V. N. Platonov, 1998; V. B. Avdienko et al., 2005, I. N. Solopov) [2]. Control over the activity of adaptation mechanisms is carried out along two contours. Minimal participation of the central circuit provides the underlying regulatory systems with a large number of degrees of freedom and helps to achieve a functional optimum (V.V. Parin, R.M. Baevsky) [6].

HRV indicators have certain differences associated with the characteristics of different sports. For

our study, the differences in the indicators of the total power of the spectral waves TP were very important [4].

Objective of the study was to assess the effectiveness of the Varicard system in optimizing the training regimen for elite swimmers.

Methods and structure of the study. The research work was conducted over two years during the preparation of swimmers of the Russian national team at year-round centralized training events. The observation involved 30 qualified athletes: 10 masters of sports, 14 masters of sports of international class, 6 honored masters of sports.

The task was to use the HRV indicators in training management during the selected period, the same for the control and experimental groups.

The conditions for the experiment, confirming the equivalence of the two groups, were: swimming specialization - distances up to 200 meters, WA (World Aquatics - former FINA) score level of at least 800 points, mixed groups - men and women, performance at the same competitions at the same time.

The study used the VARICARD complex and the ISCIM6 program. The standard scenario of «sitting position» at rest was used. Athletes visited the treatment room in the evening, after the training day, strictly according to an individual schedule. The minimum number of measurements according to the regulations is twice a week. The following HRV indices were used: TI – tension index, TP – index of total spectral wave power, HR, PARS – index of regulatory systems activity, PAPR – index of regulation process activity, pNN50, MxDMn – variation range. Individual dynamics of changes in the listed indices were taken into account. With the help of the above-mentioned HRV indices, practical changes were made to the training plan of the weekly microcycle. The experimental group used the method of minor correction taking into account the obtained criterion assessments and pedagogical interpretation of the data. The control group did not

Table 1. Interdependence of HRV indicators

Indicators	Criterion	Notes
TI + TP	-0,895	Inverse correlation
pNN50 + TI	-0,838	Inverse correlation
PAPR + TI	0,949	Direct dependence
TP + MxMDn	0,928	Direct dependence

Table 2. Criteria for HRV indicators

Indicators	Norm	Correction
TP	**1100 - 5000**	Work in any zones
TI	**20 - 170**	
PARS	**1-4**	
Indicators	**Norm**	**Correction**
TP	**<1100**	Work in compensatory zones
TI	**>300**	
PARS	**5-7**	
Indicators	**Norm**	**Correction**
TP	**>6000**	Work in zones A1 and A2
TI	**>200**	
PARS	**8-10**	

Table 3. Example of individual changes in HRV

TP																					
Спортсмен	Ж.П.	С. А.	Ч. Е.	Ж. А.	Д. М.	З. Н.	С. П.	К. К.	В. М.	К. А.	О. А.	Л. К.	Т. Д.	Г. Н.	Р. Е.	Р. В.	Д. Е.	П. П.	Ж. Д.	Б. Т.	С. В.
Нагрузка																					
ПАНО	1872	2747	2675	2098	1906	1448	4990	2788	2604	3019	4574	2517	1895	4157	4043	781	2146	2925	2118	1572	4791
МПК	840	487	710	434	771	497	981	406	892	1819	1149	1090	472	2028	1318	188	343	759	548	668	958
Гликолиз	1339	1556	910	1102	3862	824	1263	1144	6523	6939	2967	1485	769	9928	1675	497	608	8166	1149	927	1141

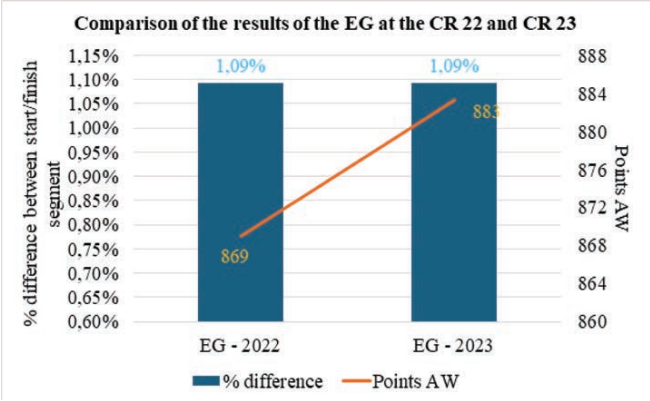
ИН																					
Спортсмен	Ж.П.	С. А.	Ч. Е.	Ж. А.	Д. М.	З. Н.	С. П.	К. К.	В. М.	К. А.	О. А.	Л. К.	Т. Д.	Г. Н.	Р. Е.	Р. В.	Д. Е.	П. П.	Ж. Д.	Б. Т.	С. В.
Нагрузка																					
ПАНО	156	88	66	110	171	116	83	21	75	102	94	82	148	35	41	320	145	102	171	259	38
МПК	271	323	328	641	328	295	338	632	192	163	225	183	848	132	147	1390	707	356	281	214	160
Гликолиз	186	173	462	137	125	205	270	215	31	48	130	175	340	67	148	296	326	21	295	149	192

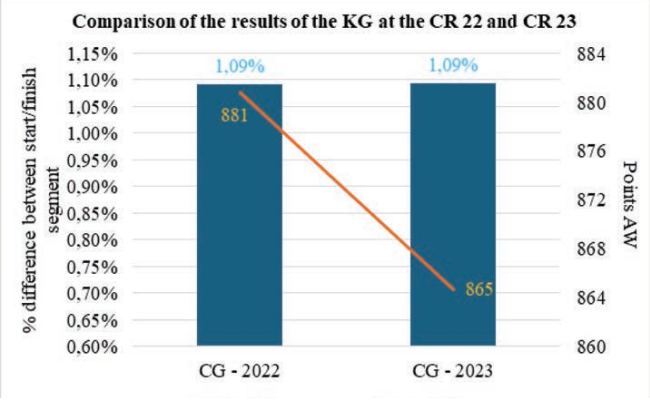
ПАРС																					
Спортсмен	Ж.П.	С. А.	Ч. Е.	Ж. А.	Д. М.	З. Н.	С. П.	К. К.	В. М.	К. А.	О. А.	Л. К.	Т. Д.	Г. Н.	Р. Е.	Р. В.	Д. Е.	П. П.	Ж. Д.	Б. Т.	С. В.
Нагрузка																					
ПАНО	3	3	4	2	3	1	6	6	2	6	6	5	4	3	7	6	3	4	7	5	5
МПК	6	5	6	9	8	3	7	4	5	8	4	5	7	2	1	10	8	8	4	6	3
Гликолиз	4	5	6	5	4	1	8	2	7	7	4	5	6	4	2	6	5	7	8	6	3

make any changes to the training at different stages of preparation, receiving data.

Results of the study and discussion. During the observation period, 3820 measurements of highly qualified swimmers were taken under the conditions of training events held by the Russian Swimming Federation at the Olympic base «Lake Krugloe». The proposed training format allows observing changes in the functional state of athletes. The interdependence of the used HRV indicators is determined by the method of mathematical statistics. Table 1 shows the values.

It is worth noting that the MxDMn variation range indicators are used by us to determine the pathological condition and a reactive change above 650 ms [14] can serve as a basis for additional consultation with the team doctor. The PARS indicators, although they have program criteria, were developed by Baevsky R. M. not for athletes and in assessing the state of regulatory systems have a reliable connection mainly with high point scores - 1-2 (physiological norm zone). Table 2 shows the criteria for indicators developed during the experiment that are most dependent on the state of the body after training work – TP, pNN50, Tension Index.





Start/Finish Segment Deterioration Percentage

Table 3 shows the HRV indices in swimmers after training in the PAN, Glycolysis, and maximum anaerobic power zones.

In the case where the indicators of the tension of the regulatory systems had a pronounced centralization (PAPR), the other taken into account indicators of the HRV changed interdependently. The pedagogical interpretation of the results was expressed in reducing the load on the next day, maintaining the planned work and, in rare cases, increasing the load. The task of the coaches was to make a moderate adjustment to the training program of the next training day. The changes mostly concerned a decrease in intensity. A similar scheme in training management was used at each stage of preparation. After the experiment, the results shown at the competitions by the observed athletes were assessed using the SPLIT SMASH MANAGER electronic system. The results of the comparison of the control and experimental groups at the Russian Championships in 2022 and 2023 are shown. The figure shows the percentage of deterioration in the speed of the starting 50-meter and finishing 50-meter segments for each swimmer who participated in the study (see figure).

Conclusions. The problem of effective control over the management of an athlete's training will always be one of the key tasks of growth and improvement of sports skills. A promising direction for this will be control over the course of adaptation processes of the athletes' body. The presence of athletes in a group whose hardware measurement indicators will correlate with available non-invasive methods for determining their current state will simplify the problem of current control by the coach. This, in turn, will help avoid methodological errors when planning the training process.

References

1. Avdienko V.B., Solopov I.N. Iskusstvo trenirovki plovtsa. The trainer's book. Moscow: OOO ITRK publ., 2019. 320 p.
2. Avdienko V.B., Solopov I.N. Metodologicheskiye osnovy podgotovki plovtsov. Fizicheskoye vospitaniye i sportivnaya trenirovka. Mediko-biologicheskiye aspekty fizicheskogo vospitaniya i sportivnoy trenirovki. 2019. No. 1 (27). pp. 73-83.
3. Baevskiy R.M., Semenov Yu.N., Chernikova A.G. Analiz variabel'nosti serdechnogo ritma s pomoshchyu kompleksa «Varikard» i prob-

lema raspoznavaniya funktsionalnykh sostoyaniy. Khronobiologicheskiye aspekty arterialnoy gipertenzii v praktike vrachebno-letnoy ekspertizy. Moscow. 2000. pp. 167-178.
4. Bersenev E.Yu. Sportivnaya spetsializatsiya i osobennosti vegetativnoy regulyatsii serdechnogo ritma. Proceedings IV IV All-Russian symposium. «Variabelnost serdechnogo ritma: teoreticheskiye aspekty i prakticheskoye primeneniye». 19-21 noyabrya 2008, Izhevsk. 2008. pp. 42-45.
5. Vikulov A.D., Bocharov M.V., Kaunina D.V., Boykov V.L. Regulyatsiya serdechnoy deyatelnosti u sportsmenov vysokoy kvalifikatsii. Vestnik sportivnoy nauki. 2017. No. 2. pp. 31-36.
6. Gavrilova E.A. Ispolzovaniye variabelnosti ritma serdtsa v otsenke uspeshnosti sportivnoy deyatelnosti. Prakticheskaya meditsina. 2015. No. 3 (1). pp. 52-57.
7. Gavrilova E.A. Sport, stress, variabelnost. Monograph. Moscow: Sport publ., 2015. 168 p.
8. Pankov D.A., Chernogorov D.N. Tekhnologii upravleniya fizicheskoy nagruzkoy v plavanii. Vestnik Moskovskogo gorodskogo pedagogicheskogo universiteta. Seriya: Yestestvennyye nauki. 2021. No. 1(41). pp. 41-51.
9. Safonov L.V., Aranson M.V. Osobennosti tselevogo primeneniya vnetrenirovochnykh sredstv povysheniya rabotosposobnosti i korrektsii utomleniya u vysokokvalifitsirovannykh sportsmenov. Vestnik sportivnoy nauki. 2016. No. 4. pp. 40-44.
10. Seyranov S.G., Bulgakova N.Zh., Evseev S.P., Fomichenko T.G. K voprosu o nedostatkakh i protivorechiyakh sistemy podgotovki sportivnogo rezerva v Rossiyskoy Federatsii. Vestnik sportivnoy nauki. 2021. No. 1. pp. 21-27.
11. Solomatin V.R. Osobennosti fiziologicheskogo vozdeystviya nepreryvnogo i intervalnogo metodov trenirovki na kvalifitsirovannykh yunykh plovtsov. Vestnik sportivnoy nauki. 2020. No. 6. pp. 52-55.
12. Chernogorov D.N., Matveev Yu.A. Dinamicheskiye issledovaniya variabelnosti serdechnogo ritma i dispersionnogo kartirovaniya elektrokardiogrammy u tyazheloatletov razlichnogo urovnya podgotovki. Sportivnaya meditsina: nauka i praktika. 2016. No. 1. pp. 15-20.

Polyunsaturated fatty acids and amino acids for athletes: impact on physical activity

UDC 796.035:613.2

PhD, Associate Professor **N.D. Nenenko**[1]
Dr. Biol., Associate Professor **M.V. Stogov**[1]
M.P. Tolokova[1]
M.F. Kamalova[1]
[1]Yugra State University, Khanty-Mansiysk

Corresponding author: nenenkon@mail.ru

Received by the editorial office on 04.07.2024

Abstract

Objective of the study was to examination of the effectiveness of polyunsaturated fatty acids (PUFA) and branched side chain amino acids (BCAA) in physical education.

Methods and structure of the study. The process of locating relevant literary information involved utilizing the publicly accessible electronic repositories of scholarly publications, PubMed and eLibrary.

Results and conclusions. The findings suggest that the use of dietary supplements containing polyunsaturated fatty acids (PUFA) and branched-chain amino acids (BCAA) in the context of physical training can effectively enhance muscle performance and resilience.

The literature suggests that the optimal duration of PUFA supplementation is eight weeks, with a daily dose of 4-5 grams. For BCAA, the recommended duration is no more than 16 weeks, with a daily dose of 2-10 grams.

When these supplements are combined, they can work together to accelerate muscle recovery after exercise.

Keywords: *polyunsaturated fatty acids, amino acids with branched side radicals, sports nutrition, mode of application, physical activity*

Introduction. Improving the health and quality of life of the general population is a priority task of physical culture and mass sports [1]. Currently, there is a search for effective health improvement technologies, as well as means and methods for optimizing those already in use. Among the methods being developed for optimizing health technologies, nutraceutical support occupies a significant place. In this area, a fairly large number of works are devoted to assessing the use of biologically active substances (vitamins, provitamins, etc.), including polyunsaturated fatty acids (PUFA) and amino acids with branched side chains (BCAA) – leucine, isoleucine and valine [6, 11]. At the same time, if the schemes for using these supplements are sufficiently developed within the framework of sports training [12], then data on the rational choice of schemes for using nutraceutical support for individuals involved in physical culture are quite scarce [3].

Objective of the study was to examination of the effectiveness of polyunsaturated fatty acids (PUFA) and branched side chain amino acids (BCAA) in physical education.

Methods and structure of the study. The literature search was conducted using open electronic databases of scientific literature PubMed and eLIBRARY. The following search query was used for the search: «fitness», «sports nutrition», «polyunsaturated fatty acid AND fitness», «BCAA AND fitness». For the analysis of literature data, full-text sources and/or sources with structured abstracts were evaluated. Abstracts of reports, unpublished works and experimental studies on animals were not analyzed.

Results of the study and discussion. The conducted analysis of the literature data demonstrates that the use of PUFA-based food supplements in the practice of physical education and sports is considered as an ergogenic means demonstrating certain abilities to modulate mus-

cle responses to exercise by stimulating muscle hypertrophy, increasing their endurance, strength characteristics, and power [14]. In addition, due to their anti-inflammatory properties, PUFA supplements can minimize muscle damage caused by physical exercise [15]. However, some authors do not find the effects of PUFA use described in their studies [7]. The reason for this, in our opinion, is that the daily dose and duration of use of PUFA-based supplements vary significantly from study to study, and there are no clear application schemes. In this regard, for the selection of such optimal PUFA application schemes among all the literature material found, two systemic reviews [4, 9] deserve attention, which contain information on the comparative effectiveness of various schemes for the use of PUFA-based supplements in the practice of physical education. The results of the most evidence-based studies noted in these reviews have been summarized and presented in a table.

In most of the studies we reviewed, the authors assessed the effectiveness of PUFA use by three indicators: muscle mass gain, muscle strength and power gain, and increased muscle recovery rate after exercise. In the table, we indicate the PUFA use regimens (daily dose in grams and duration) that showed a significant increase in the effectiveness indicators in the groups of men and women (18-50 years old) taking PUFA, as opposed to the groups that did not take this supplement. The table shows that the course duration of PUFA intake in the target group varied from 7 (1 week) to 90 days, with the daily prescribed dose fluctuating from 0,86 to 6 g. It is also obvious that the main effect of PUFA use concerned increased muscle strength and increased muscle recovery rate after exercise. In the largest number of studies, in which the effect was developed for both men and women, the duration of PUFA use was eight weeks at a daily dose of 4-5 g. In our opinion, these values can be considered basic for the use of PUFA-based dietary supplements by mature individuals involved in physical education.

Separately, we found a study that showed the effectiveness of using PUFA in combination with vitamin E at a dose of 10 g per day for at least 21 days in highly qualified athletes [2]. According to the results of the study, such a complex use contributed to an increase in the target contingent's performance in the load power zone, an immunoreactive effect was noted. These data make the use of PUFA in combination with fat-soluble vitamins promising.

The effects of BCAA use described in the literature, in contrast to PUFAs, which have a wider range of effects, are associated with the ability of BCAA to minimize the effects of muscle loads by increasing the rate of post-load recovery of muscle fibers [8]. It should also be noted that, unlike the PUFA application schemes used, the BCAA application schemes we found in available sources are quite similar. First of all, all studies have noted the effectiveness of BCAA in the proportion of L-leucine, L-isoleucine, L-valine - 2:1:1, with a daily dose for mature individuals of both sexes from 2 to 10 g with a duration of use of up to 16 weeks [10]. Moreover, for BCAA, the optimal time of administration is also noted - before the start of training or exercise [5]. It is important to note that we also came across a study that studied the effectiveness

Scheme of application of PUFA-based supplements in physical education practice based on data from [9, 10]

Gender	Muscle mass growth (daily dose, g/duration of use)	Increase in strength, power (daily dose, g/duration of use)	Increase in the rate of muscle recovery after exercise (daily dose, g/duration of use)
Men (18-50 years)	4-5 g / 6-8 weeks	0,86 g / 8 weeks 1,2 g / 26 days 4 g / 6 weeks 2,4 g / 8 weeks 4,5 g / 10 weeks	0,86 g / 8 weeks 1,2 g / 26 days 1,8 g / 4 weeks 2,4 g / 8 weeks
Women (18-50 years)	4-5 g / 6-8 weeks	2 g/90 days 6 g/1 week 6 g/12 weeks 5 g/8 weeks	3 g /9 days 2 g /6 weeks 5 g /8 weeks

of the combined use of a PUFA and BCAA complex [13]. Positive effects are noted in the use of 0,86 g per day of PUFA for eight weeks and 9,6 g per day for eight days on the rate of muscle recovery in young men who do not play sports after eccentric loads. In general, our assessment of the literature suggests that the use of PUFAs and BCAAs can promote increased physical performance in mature individuals involved in physical exercise. The main expected effect of using both PUFAs and BCAAs is an increase in the rate of skeletal muscle recovery after physical exertion. Moreover, the combined use of these supplements can have a synergistic effect, the basis for this is the results of the above-mentioned work [13].

An important conclusion from all the studies we analyzed is also that the authors of the presented studies do not provide data on any adverse events in the subjects that could be associated with the use of food supplements, which indicates their acceptable safety for the health of those exercising.

Nevertheless, the results of the literature analysis allow us to identify some limitations in the use of these supplements. Thus, the use of PUFAs, due to the possibility of their accumulation in the body, should be limited in duration and / or dosage. In particular, the literature data (table) showed that the longer the course of PUFA use, the lower the daily dose. In turn, for BCAA, long-term use can contribute to the development of side effects associated with the need to utilize the amino nitrogen of the consumed amino acids, increasing the load on the liver and kidneys. The latter circumstance, in our opinion, requires limiting the intake of BCAA to no more than 10 g/day.

Conclusions. Thus, the analysis of literary data allows us to determine that the basic scheme for the use of PUFAs for both men and women involved in physical education can be considered the use of the supplement for 8 weeks at a daily dose of 4-5 g, the use of BCAA (in the proportion: L-leucine, L-isoleucine, L-valine 2: 1: 1) – no more than 10 g / day. The complex use of these supplements, providing a synergistic effect of their use, is promising.

The study was carried out at the expense of the grant of the Russian Science Foundation No. 24-25-20013 (https://rscf.ru/project/24-25-20013/) and the Department of Education and Science of the Khanty-Mansiysk Autonomous Okrug - Yugra.

References

1. Gergunova P.A. Problema razgranicheniya ponyatiy «fizicheskaya kultura» i «massovyy sport». Innovatsii. Nauka. Obrazovaniye. 2022. No. 69. pp. 270-273.
2. Isaev V.A., Bentsianova N.V. Biologicheski aktivnyye dobavki dlya effektivnogo i bezopasnogo pitaniya sportsmenov vysshey kvalifikatsii. Ratsionalnoye pitaniye, pishchevyye dobavki i biostimulyatory. 2016. No. 4. pp. 13-19.
3. S de Souza R.A., da Silva A.G., de Souza M. F. et all. A Systematic Review of CrossFit® workouts and dietary and supplementation interventions to guide nutritional strategies and future research in CrossFit®. Int. J. Sport Nutr. Exerc. Metab. 2021. Vol. 31. No 2. pp. 187-205.
4. Da Boit M., Hunter A.M., Gray S.R. Fit with good fat? The role of n-3 polyunsaturated fatty acids on exercise performance. Metabolism, publ. 2017. Vol. 66. pp. 45-54.
5. Ra S.G., Miyazaki T., Kojima R. et all. Effect of BCAA supplement timing on exercise-induced muscle soreness and damage: a pilot placebo-controlled double-blind study. J. Sports Med. Phys. Fitness. 2018. Vol. 58. No. 11. pp. 1582-1591.
6. Capo X., Martorell M., Busquets-Cortes C. et all. Effects of dietary almond- and olive oil-based docosahexaenoic acid- and vitamin E-enriched beverage supplementation on athletic performance and oxidative stress markers. Food Funct. 2016. Vol. 7. No. 12. pp. 4920-4934.
7. Mackay J., Bowles E., Macgregor L. J. et all. Fish oil supplementation fails to modulate indices of muscle damage and muscle repair during acute recovery from eccentric exercise in trained young males. Eur. J. Sport Sci. 2023. Vol. 23. No. 8. pp. 1666-1676.
8. Foure A., Bendahan D. Is branched-chain amino acids supplementation an efficient nutritional strategy to alleviate skeletal muscle damage? A systematic review. Nutrients, publ.. 2017. Vol. 9. No. 10. 1047 p.
9. Heileson J.L., Funderburk L.K. The effect of fish oil supplementation on the promotion and preservation of lean body mass, strength, and recovery from physiological stress in young,

healthy adults: a systematic review. Nutr. Rev. 2020. Vol. 78. No. 12. pp. 1001-1014.
10. Arroyo-Cerezo A., Cerrillo I., Ortega A. et all. Intake of branched chain amino acids favors post-exercise muscle recovery and may improve muscle function: optimal dosage regimens and consumption conditions. J. Sports Med. Phys. Fitness. 2021. Vol. 61. No. 11. pp. 1478-1489.
11. Plotkin D.L., Delcastillo K., Every van D.W. et all. Isolated leucine and branched-chain amino acid supplementation for enhancing muscular strength and hypertrophy: a narrative review. Int. J. Sport Nutr. Exerc. Metab. 2021. Vol. 31. No. 3. pp. 292-301.
12. Stellingwerff T., Peeling P., Garvican-Lewis L.A. et all. Nutrition and altitude: strategies to enhance adaptation, improve performance and maintain health: a narrative review. Sports Med. 2019. Vol. 49 (Suppl 2). pp. 169-184.
13. Tsuchiya Y., Yanagimoto K., Sunagawa N. et all. Omega-3 fatty acids enhance the beneficial effect of BCAA supplementation on muscle function following eccentric contractions. J. Int. Soc. Sports Nutr. 2022. Vol. 19. No. 1. pp. 565-579.
14. Philpott J. D., Witard O. C., Galloway S. D. R. Applications of omega-3 polyunsaturated fatty acid supplementation for sport performance. Res. Sports Med. 2019. Vol. 27. No. 2. pp. 219-237.
15. Kyriakidou Y., Wood C., Ferrier C. et all. The effect of Omega-3 polyunsaturated fatty acid supplementation on exercise-induced muscle damage. J. Int. Soc. Sports Nutr. 2021. Vol. 18. No. 1. 9 p.

Training loads and heart rate variability of young skiers

UDC 796/799

PhD, Associate Professor **I.E. Anpilogov**[1]
PhD, Associate Professor **P.V. Pavlov**[1]
[1]Kursk State University, Kursk

Corresponding author: anpilogov.sport@yandex.ru

Received by the editorial office on 07.06.2024

Abstract

Objective of the study was to evaluation of the changes in the relationships and fluctuations between the indicators of heart rate variability in young skiers during a training session.

Methods and structure of the study. Heart rate variability was assessed in 12 mass-class skiers aged 13,2±0,4 years using the MS FIT system (Medicalsoft, RF) before and after exercise in a sitting position. The training load was a cross-country run with an imitation of an uphill run alternating with running. Five series of 10 repetitions of an uphill run of 150 m with a slope of 7-9° were performed.

Results and conclusions. The correlation between the indicators of the heart muscle's performance undergoes a substantial transformation under the influence of physical exertion. The assessment of athletes' functional status and their performance solely based on quantitative HRV data, without considering the evolution of the correlation, can result in an erroneous interpretation of the findings.

Keywords: *performance, heart rate variability, young skiers, training process*

Introduction. Evaluation of physical performance, the degree of impact of the training load on the body of those involved is the most important component of the effectiveness of the training process [3].

Analysis of scientific and methodological literature shows that at present the condition and performance of athletes are assessed mainly using testing procedures with an assessment of the level of lactate in the blood and spirometry [3, 5]. At the same time, there is enough data in the literature indicating the possibilities of autonomous analysis of ECG data, which allow us to draw conclusions about the actual individual parameters of the functional state of athletes without the use of expensive equipment and invasive research methods [5].

One of the areas of assessing the adaptation processes in the body over a long period of time is the analysis of heart rate variability (HRV). According to the results of studies, HRV is an emerging property of interdependent regulatory systems that operate on different time scales, helping an individual to adapt to challenges of various natures. It is noted that the dynamics of HRV is a nonlinear system, the variability of which allows you to quickly adapt in an uncertain and changing environment [3].

HRV includes a number of time domain indicators, frequency domain indicators, and nonlinear measurements. According to a number of studies, there is a close relationship between the indicators of these areas, which allows for the formation of an optimal HRV level, which contributes to the process of self-regulation and adaptability to constantly changing environmental conditions [4, 5, 6].

Objective of the study was to evaluation of the changes in the relationships and fluctuations between the indicators of heart rate variability in young skiers during a training session.

Methods and structure of the study. The scientific work involved 12 mass-class skiers aged 12-15 years. Heart rate variability was assessed using the MS FIT system (Medicalsoft, RF) before and after exercise in a sitting position. The train-

ing load was a cross-country run with an imitation of an ascent alternating with running. Five series of 10 repetitions were performed in an ascent of 150 m with a slope of 7-9°. When assessing HRV, we analyzed the following parameters: heart rate (HR), standard deviation of normal sinus contractions (SDNN), root mean square of successive differences between normal heart contractions (RMSSD), number of adjacent NN intervals differing from each other by more than 50 ms (NN50), percentage of adjacent NN intervals differing from each other by more than 50 ms (pNN50), low-frequency range VF (0,04–0,15 Hz), high-frequency or respiratory range HF (0,15–0,40 Hz), LF to HF power ratio (LF/HF), and total HRV spectrum power (PT). Statistical analysis of the obtained results was performed using the IBM SPSS Statistics 27.0.1 software package with calculation of the Spearman rank correlation coefficient. The critical value at P 0,05 was 0,58, at P 0,01 – 0,71 [1].

Results of the study and discussion. The results of calculating the correlation matrix between the indicators of the time and frequency ranges of HRV recorded in the resting state are presented in Table 1.

The analysis of the obtained data shows that the values of the frequency and time ranges for a number of indicators have a strong relationship in the resting state of young athletes. Thus, the standard deviation of normal sinus contractions (SDNN) closely correlates with the time range indicators (RMSSD, NN50, pNN50), as well as with the HRV power indicators in the high-frequency range (HF), and the total power (TP). The obtained results are consistent with the data of the scientific and methodological literature [3, 5]. The researchers note that the SDNN values are equally influenced by both the sympathetic and parasympathetic systems. At the same time, in the conditions of short-term recordings at rest, the main source of variations is parasympathetically mediated respiratory sinus arrhythmia [6]. This is indicated by the correlation level of 0,87 between SDNN and HF. A number of relationships in the frequency domain are also noteworthy.

Thus, in the low-frequency to high-frequency power ratio, the highest correlation is observed between LF/HF and LF. It can be assumed that this indicates a greater contribution of low-frequency oscillations to this indicator.

At the same time, there is no consensus in the scientific and methodological literature on the interpretation of the LF/HF ratio data. The main assumption is that low-frequency power can be generated by the sympathetic nervous system, while high-frequency power can be generated by the parasympathetic nervous system [3, 5]. At the same time, there is data indicating that this assumption is controversial [6]. According to the data obtained, the contribution of LH to the LF/HF ratio is significantly higher, which is confirmed by the correlation relationship between these indicators, recorded at the level of 0,80. However, the correlation between the total power and high-frequency power is 0,81, which indicates a greater contribution of the parasympathetic component to this indicator.

After the completion of the training session, the correlation relationships between the recorded indicators changed significantly (Table 2). The analysis of the obtained results shows that the correlation value between the SDNN and LF indicators increased from -0,24 to -0,51, the relationship between SDNN and PT decreased from 0,98 to 0,41. Upon completion of the training work, the athletes showed no relationship between such indicators as NN50 and HF, NN50 and PT, while before the load the level of correlation between these indicators was 0,98 and 0.95, respectively. Also noteworthy is the increased relationship between the

Table 1. Correlation relationships between HRV indicators before the start of the training session

	SDNN	RMSSD	RR	NN50	pNN50	LF	HF	LF/HF	PT
SDNN									
RMSSD	0,87**								
RR	-0,32	0,70*							
NN50	0,92**	0,98**	-0,61*						
pNN50	0,87**	0,99**	-0,70*						
LF	-0,24	-0,12	0,16	-0,25	-0,12				
HF	0,87**	0,99**	-0,70*	0,98**	0,99**	-0,11			
LF/HF	-0,72*	-0,68*	0,50	-0,77**	-0,68*	0,80**	-0,68*		
PT	0,98**	0,81**	-0,23	0,85**	0,81**	-0,15	0,81**	-0,62*	

** The reliable level of the correlation coefficient is at p<0,05; ** The reliable level of the correlation coefficient is at p<0,01.*

Table 2. Correlation relationships between HRV indicators after a training session

	SDNN	RMSSD	RR	NN50	pNN50	LF	HF	LF/HF	CM
SDNN									
RMSSD	0,90**								
RR	-0,19	-0,10							
NN50	0,52	0,73**	0,54						
pNN50	0,87**	0,99**	-0,10	0,75**					
LF	-0,51	-0,18	0,59*	0,34	-0,13				
HF	0,69*	0,78**	-0,41	0,28	0,77**	-0,26			
LF/HF	-0,77**	-0,50	0,50	0,05	-0,45	0,93**	-0,50		
PT	0,41	0,43	-0,24	0,02	0,39	-0,01	0,76**	-0,19	

** The reliable level of the correlation coefficient is at P>0,05; ** The reliable level of the correlation coefficient is at P>0,01.*

low-frequency power (LF) indicators and the LF/HF ratio, while the relationship between the total power (PT) and the high-frequency power (HF) indicator decreases to 0,76.

The role of the respiratory rate (RR) also increases significantly in the final configuration of the relationships between the indicators. Thus, the correlation links between RR and NN50 from -0,61 are transformed into 0,54, which, in our opinion, indicates the role of the respiratory system in the regulation of HRV during physical exertion, and the correlation between RR and LF also increases significantly from 0,16 to 0,59. The information content of changes in the closeness of the relationship between instantaneous HR and the respiratory cycle for the early detection of overtraining in athletes was noted in the domestic literature [2].

Conclusions. The conducted study allows us to state that the relationships between the indices of cardiac muscle functioning significantly change under the influence of physical activity. According to the data of scientific and methodological literature, the analysis of HRV is actively used as a non-invasive method of assessing the functional state of athletes and their level of performance [5], at the same time, the assessment of only quantitative data without assessing the dynamics of the relationship, in our opinion, does not allow us to identify cause-and-effect relationships in the dynamics of the indices, which in turn can lead to an incorrect interpretation of the results obtained. Also, the dynamics of HRV is significantly affected by the age and level of training of those involved, which is also an important factor in the analysis of the data obtained.

References

1. Bavrina A.P. Sovremennyye pravila ispolzovaniya metodov opisatelnoy statistiki v mediko-biologicheskikh issledovaniyakh. Meditsinskiy almanakh. 2020. No. 2 (63). pp. 95-104.
2. Tsydypov Ch.Ts. Pulsovaya diagnostika v tibetskoy meditsine (Problemy avtomatizatsii). Ulan-Ude, 1985. 47 p.
3. Kaikkonen Piia & Nummela Ari & Rusko Heikki. (2008). Heart rate variability dynamics during early recovery after different endurance exercises. European journal of applied physiology. 102. 79-86. 10.1007/s00421-007-0559-8.
4. Pol R., Balague N., Ric A. *et al.* Training or Synergizing? Complex Systems Principles Change the Understanding of Sport Processes. *Sports Med - Open* **6**, 28 (2020).
5. Scherer, Matthias & Martinek, Johannes & Mayr, Winfried. (2019). HRV (Heart Rate Variability) as a non-invasive measurement method for performance diagnostics and training control. Current Directions in Biomedical Engineering. 5. 97-100. 10.1515/cdbme-2019-0025.
6. Shaffer Fredric & Ginsberg Jp. (2017). An Overview of Heart Rate Variability Metrics and Norms. Frontiers in Public Health. 5. 258. 10.3389/fpubh.2017.00258
7. Umetani Ken & Singer Donald & McCraty Rollin & Atkinson Mike. (1998). Twenty-Four Hour Time Domain Heart Rate Variability and Heart Rate: Relations to Age and Gender Over Nine Decades. Journal of the American College of Cardiology. 31. 593-601. 10.1016/S0735-1097(97)00554-8.

Sport as a means of coping with negative feelings for young people

UDC 796/799

Postgraduate student **S. Tsyuy**[1]
Postgraduate student **A.E. Voronova**[1]
Postgraduate student **M. Namazifard**[1]
PhD **A.N. Zakharova**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: azakharova91@gmail.com

Received by the editorial office on 28.05.2024

Abstract

Objective of the study was to examine the impact of physical activity on anxiety, depression, and stress in young individuals through a meta-analysis.

Methods and structure of the study. A comprehensive literature review was conducted through a systematic search of electronic bibliographic databases, including PubMed, Web of Science Core Collection, MEDLINE, and Google Scholar. The PICOS method was employed for the systematic review, while the meta-analysis method was utilized for the quantitative synthesis of the collected data. The impact of physical activity on depression and anxiety was quantified, and a synthesis analysis was performed using a random effects model. The meta-analysis employed statistical indicators such as Tau2, Chi2, I2, and Z.

Results and conclusions. The results of the analysis showed a significant reduction in levels of depression and stress with the use of exercise. Physiologically, exercise promotes the release of neurotransmitters (endorphins and dopamine), which help improve mood and relieve depression [3]. Physical education classes have a positive effect not only on a persons psychological state, but also allow them to improve many functions of the body, increase a persons immunity, and improve the organization of work and rest.

Keywords: *exercise, sport, young people, negative emotions, anxiety, depression, stress, meta-analysis*

Introduction. In modern society, mental health problems of young people are attracting increasing attention. In the era of information technology development and fierce competition, high school and university students are faced with negative emotions. These problems have begun to have a significant impact on their growth and development processes [1]. If these problems are ignored, it can lead to even worse consequences, such as smoking, alcohol abuse, violence, drug use, and suicidal behavior [4].

Objective of the study was to examine the impact of physical activity on anxiety, depression, and stress in young individuals through a meta-analysis.

Methods and structure of the study. A comprehensive literature review was conducted through a systematic search of electronic bibliographic databases, including PubMed, Web of Science Core Collection, MEDLINE, and Google Scholar. The PICOS method was employed for the systematic review, while the meta-analysis method was utilized for the quantitative synthesis of the collected data. The impact of physical activity on depression and anxiety was quantified, and a synthesis analysis was performed using a random effects model. The meta-analysis employed statistical indicators such as Tau^2, Chi^2, I^2, and Z.

In meta-analysis, Tau^2, Chi^2, I^2, and Z are important statistics used to evaluate and present the results of studies. Tau^2 is a measure of heterogeneity, which is the amount of variance between studies. It reflects the true differences between study results, rather than the variance due to sampling error. A larger Tau^2 value indicates greater variance between studies, which implies greater heterogeneity. A high Tau^2 value suggests that the differences between study results are substantial,

possibly due to differences in study design, participants, treatments, and other factors.

Chi^2 is a statistic used to test for heterogeneity, assessing whether there are significant differences between study results. When the Chi^2 value is large and the corresponding p-value is small, it indicates significant heterogeneity between studies.

I^2 is a measure of heterogeneity, indicating the percentage of total variation that is due to heterogeneity rather than chance. It quantifies the degree of heterogeneity. I^2 values range from 0% to 100%, with higher values indicating greater heterogeneity.

The Z statistic is commonly used to test the overall effect, determining whether the pooled effect size is significant. Larger Z values indicate a larger combined effect.

Results of the study and discussion. The search strategy yielded a total of 384 results. Ten studies [2–14] met the inclusion criteria for this meta-analysis (see Table). The 10 included studies involved 879 participants with a mean age of 18,13±2,67 years.

Anxiety. The effect size for anxiety was -5.78 with a 95% confidence interval of [-13,88, 2,32]. This suggests that exercise has some effect on reducing anxiety, but the exact effect size is unclear. Heterogeneity analysis showed differences in anxiety levels across studies. The overall effect test yielded a Z value of 1,40 with a p value of 0,16, which is not statistically significant. Therefore, the overall effect of exercise on reducing anxiety is not significant.

Depression. The synthesized effect size of exercise on depression was -6,59 with a 95% confidence interval of [-10,22, -2,96]. Heterogeneity analysis showed differences in depression levels across studies. The overall effect test yielded a Z value of 3,56 with a p value of 0,0004, indicating that the overall effect of exercise on reducing depressive mood is significant.

Stress. The synthesized effect size of physical exercise on stress was -6,70 with a 95% confidence interval of [-12,77, -0,62]. The heterogeneity analysis showed differences in stress levels across studies. The overall effect test showed a Z value of 2,16 with a p value of 0,03, indicating statistical significance of the synthesized effect. This means that exercise can reduce stress to some extent. The results of the analysis showed a significant decrease in depression and stress levels with the use of physical exercise. From a physiological point of view, exercise promotes the release of neurotransmitters (endorphins and dopamine), which improve mood and relieve depression [3]. The use of physical exercise reduces the level of the stress hormone (cortisol) [5]. From a psychological and sociological point of view, participation in sports activities helps adolescents gain self-confidence. Sports provide adolescents with an opportunity to increase their social recognition among peers, which ensures safety. Sports help teenagers discipline themselves, develop organizational and leadership skills, which help them better cope with life's difficulties, thereby reducing anxiety and depression.

Data included in the studies

Research (Author, Year)	Sample size	Physical activity	The impact of physical activity	Scale
Papp 2019	44	Yoga	Anxiety, depression, stress	HAD, PSS
Chung 2021	228	Adventure-based training	Depression	RS-14
Yan 2023	52	Physical activity	Anxiety	N-QOL
Noggle 2012	51	Yoga	Anxiety, depression, stress	POMS-SF, PSS
Saltan & Ankarali 2021	92	Pilates	Depression	BDI
Xiao 2021	97	Basketball, Qigong Baduanjin	Anxiety, stress	SAS, PSS
McGale 2011	104	Physical activity	Depression	BDI
Philippot 2022	52	Physical activity	Anxiety, depression	HAD
Zhao 2023	86	Aerobic exercise	Depression	SDS
Zhang & Jiang 2023	73	Qigong Baduanjin	Anxiety, depression	SCL-90

Note: HAD–Hospital Anxiety and Depression Scale; PSS–Perceived Stress Scale; RS-14–Resilience Scale 14; N-QOL–Nocturia Quality of Life Inventory; POMS-SF–Profile of Mood States–Short Form; BDI–Beck Depression Inventory; SAS–Self-Rating Anxiety Scale; SDS–Self-Rating Depression Scale; SCL-90–Symptom Checklist 90

Conclusions. The results of the study show that physical exercise has a positive effect on the psychological state of young people, especially in reducing depression and stress. However, there is some uncertainty about its effect on reducing anxiety, which indicates the need for further research. Physical exercise has a positive effect not only on a person's psychological state, but also helps improve many functions of the body, increase human immunity, and improve the organization of work and rest. Physical exercise helps relieve muscle and psychological tension accumulated during the day. Physical exercise is a preventive measure against many diseases. Regular physical exercise also helps improve human cognitive functions and increase brain performance. Thus, physical activity plays an important role in maintaining a person's psychological and somatic health, and can be an effective means of combating stress and depression.

References

1. American Psychiatric Association D., Association A.P. Diagnostic and statistical manual of mental disorders: DSM-5: American psychiatric association Washington, DC, 2013.
2. Chung J.O. K. Adventure based training to enhance resilience and reduce depressive symptoms among juveniles: A randomized controlled trial. Research in Nursing & Health. 2021. Vol. 44. No. 3. pp. 438-448.
3. Hackney A. C. Stress and the neuroendocrine system: the role of exercise as a stressor and modifier of stress. Expert Review of Endocrinology & Metabolism. 2006. Vol. 1. No. 6. pp. 783-792.
4. Hesketh T., Ding Q.J. et al. Anxiety and Depression in Adolescents in Urban and Rural China. Psychol Rep. 2005. Vol. 96. No. 2. pp. 435-444.
5. Hill E.E. et al. Exercise and circulating Cortisol levels: The intensity threshold effect. J Endocrinol Invest. 2008. Vol. 31. No. 7. pp. 587-591.
6. McGale N., McArdle S., Gaffney P. Exploring the effectiveness of an integrated exercise. CBT intervention for young men's mental health: Young men and mental health initiatives. British Journal of Health Psychology. 2011. Vol. 16. No. 3. pp. 457-471.
7. Noggle J.J., Steiner N.J., Minami T. Benefits of Yoga for Psychosocial Well-Being in a US High School Curriculum: A Preliminary Randomized Controlled Trial. Behavioral Pediatrics. 2012. Vol. 33. No. 3.
8. Papp M. E. A randomized controlled pilot study of the effects of 6-week high intensity hatha yoga protocol on health-related outcomes among students. Journal of Bodywork and Movement Therapies. 2019. Vol. 23. No. 4. pp. 766-772.
9. Philippot A. et al. Impact of physical exercise on depression and anxiety in adolescent inpatients: A randomized controlled trial. Journal of Affective Disorders. 2022. Vol. 301. pp. 145-153.
10. Saltan A., Ankaral H. Does Pilates effect on depression status, pain, functionality, and quality of life in university students? A randomized controlled study. Perspect Psychiatr Care. 2021. Vol. 57. No. 1. pp. 198-205.
11. Yan Z. et al. An 8-Week Peer Health Coaching Intervention among College Students: A Pilot Randomized Study. Nutrients. 2023. Vol. 15. No. 5. 1284 p.
12. Xiao T. et al. Effects of Basketball and Baduanjin Exercise Interventions on Problematic Smartphone Use and Mental Health among College Students: A Randomized Controlled Trial. Evidence-Based Complementary and Alternative Medicine. 2021. Vol. 2021. pp. 1-12.
13. Zhang Y., Jiang X. The effect of Baduanjin exercise on the physical and mental health of college students: A randomized controlled trial. Medicine. 2023. Vol. No. 34. pp. e34897.
14. Zhao Y. et al. Personalized individual-based exercise prescriptions are effective in treating depressive symptoms of college students during the COVID-19: A randomized controlled trial in China. Front. Psychiatry. 2023. Vol. 13. pp. 1015725.
15. Lubans D.R. et al. Fundamental Movement Skills in Children and Adolescents: Review of Associated Health Benefits. Sports Medicine. 2010. Vol. 40. No. 12. pp. 1019-1035.

Evaluation of special physical training of female students with different temperaments in aerobics

UDC 796.011.3

PhD, Associate Professor **E.S. Inozemtseva**[1]
PhD **N.L. Guseva**[1]
Z.S. Zemlyakova[1]
L.A. Cherepanova[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: inozemtseva@mail.tsu.ru

Received by the editorial office on 27.05.2024

Abstract

Objective of the study was to determination of differences in the parameters of special physical preparedness of female students with different types of temperament engaged in recreational aerobics.

Methods and structure of the study. The pedagogical experiment was carried out from September to May 2024 on the basis of the Department of Physical Culture and Sports of the National Research Tomsk State University in Tomsk. Educational and training sessions on health-improving aerobics for female students of each subgroup, depending on the type of temperament, were conducted according to the work program of the discipline «Physical Education». The content, intensity, and duration of educational and training sessions (twice a week for two academic hours) were the same for female students of all temperament types.

Results and conclusions. Differences in indicators of special physical preparedness of female students with different types of temperament were revealed. Significant intergroup differences ($p \leq 0.05$) were established in tests assessing endurance and dynamic balance.

In the Karsh step test, which evaluates endurance, the best result was reliably ($p \leq 0.05$) recorded in phlegmatic people in comparison with melancholic people, sanguine people and choleric people. In the test for determining dynamic balance, the best result was established by choleric people ($p \leq 0.05$) in comparison with the group of sanguine and melancholic people.

The obtained results of the study can be used in the educational and training process in physical education in educational institutions in order to improve the special physical fitness of those involved. Accordingly, taking into account temperament during recreational aerobics classes will make it possible to more effectively build the educational and training process in physical education, helping the trainer-teacher expand the components of an individual approach and determine methods of working with each student.

Keywords: *special physical, preparedness, recreational aerobics, physical culture, temperament*

Introduction. Physical education classes at the university are one of the important components of a harmoniously developed personality. NI TSU is one of the few universities where students have the opportunity to choose selected types of physical education and health technologies in the educational process in physical education. One of such physical education and health technologies is health aerobics. Musical accompaniment in different styles, high emotionality, different choreography of movements - all this allows to diversify classes with students and improves their effectiveness [2].

There is a need to build and implement the training process in aerobics not only on the basis of general psychological and pedagogical patterns, but also taking into account the methods of organizing the activities of those involved, adapted to the individual properties of the nervous system, namely, the temperament of female students [3].

The features and properties of a naturally given temperament can undergo various changes in the course of an individual's life, which are influenced by the surrounding reality. In our case, this is studying at a university. At the same time, the study of temperament characteristics belongs to the category of topics that have not yet been fully resolved in modern science.

Objective of the study was to determination of differences in the parameters of special physical preparedness of female students with different types of temperament engaged in recreational aerobics.

Methods and structure of the study. The study involved 147 second-year female students involved in health aerobics at the Department of Physical Education and Sports of the Physical Culture and Sports Department of the Tomsk National Research University. To determine the types of temperament of the respondents, a questionnaire was conducted using G. Eysenck's questionnaire [1], according to the results of which 26% were choleric, 33% were melancholic, 25% were sanguine and 16% were phlegmatic. Based on the results of the assessment of extroversion, introversion and neuroticism (according to G. Eysenck), 80 female students were classified as belonging to the pure type of temperament according to the classification of G.V. Sukhodolsky. Eighty selected female students underwent pedagogical testing in order to identify the level of development of special physical qualities (speed, general endurance, dynamic balance, strength endurance, flexibility), depending on their type of temperament. The educational and training sessions on health aerobics for female students of each subgroup, depending on their temperament type, were conducted according to the work program of the discipline «Physical Education». The content, intensity, duration of classes (twice a week for two academic hours) were the same for female students of all temperament types.

Results of the study and discussion. The results of testing the special physical fitness of female students of four types of temperament before and after the pedagogical experiment are presented in the table.

According to the data presented in the table, it was found that the initial test results revealed differences depending on the types of temperament.

The best result in the Kersh step test (to determine general endurance) was demonstrated by phlegmatic students: 116,1 ± 18,4 bpm. However, statistically significant ($p \leq 0,05$) differences in this test were revealed only in comparison with the group of melancholic students, who showed the lowest level of development of general endurance.

When assessing dynamic balance, the best result was shown by choleric students: 7,22 ± 0,1 s. However, in comparison with the group of sanguine students, no reliable differences were found ($p > 0,05$). When compared with phlegmatic and melancholic students, reliable differences are observed. When assessing speed, strength endurance and flexibility in the indicators of special physical fitness of the four types of temperaments at the beginning of the experiment, no reliable differences ($p>0,05$) were found between the groups.

In terms of speed development, the best result was demonstrated by sanguine students: 35,9±8,1 times

Results of testing special physical fitness before and after the pedagogical experiment (n=80)

The meaning of the indicators		Tests				
		Running with high hip raises, number of times	Kersh step test, bpm.	Turns on a gymnastic bench, sec	A test to determine the strength endurance of the leg and abdominal muscles, sec	Test to determine the flexibility of the spine and mobility of the hip joints, cm
sanguine	Before	35,9±8,1	121,0±23,1	8,26±1,9	74,9±21,2	36,2±18,4
	After	37,0±8,6	112,0±26,3	7,28±0,9	99,4±25,1	50,4±21,3
choleric	Before	33,3±8,0	129,3±17,4	7,22±0,1*	72,3±16,7	43,7±16,2
$\bar{X} \pm \sigma$	After	34,7±8,4	116,0±15,3	6,21±0,1*	106,0±23,2	60,0±17,1
phlegmatic	Before	35,0±6,3	116,1±18,4*	8,57±2,5	69,3±23,5	55,5±17,8
$\bar{X} \pm \sigma$	After	35,9±7,1	97,4±20,2*	6,7±2,3	108,3±25,6	62,9±18,3
melancholics	Before	35,0±8,6	133,6±26,6	8,41±1,7	84,5±17,3	37,5±21,7
$\bar{X} \pm \sigma$	After	36,1±7,4	114,1±23,8	7,56±1,9	87,8±18,4	50,9±19,6

** – Statistically significant differences between group indicators ($p \leq 0,05$).*

in 10 sec. The best result in the test to determine strength endurance was demonstrated by melancholics: 84,5±17,3 sec, the lowest result was demonstrated by phlegmatics – 69,3±23,5 sec. The best result in assessing the flexibility of the spine and mobility of the hip joints was demonstrated by the phlegmatic group: 55,5±17,8 cm.

After the pedagogical experiment, with a general tendency towards positive shifts in the indicators of physical fitness of female students in all four groups, patterns in the difference in indicators were preserved, depending on the type of temperament. Sanguine people showed the best result in the speed test, although the difference with other groups was not statistically significant ($p>0,05$). In the Kersh step test, the best result was recorded among phlegmatic people, a reliable difference ($p\leq0,05$) was observed in comparison with all other groups.

Melancholic people demonstrated a large increase in indicators in this control exercise from 133,6±26,6 beats / min to 114,1±23,8 beats / min.

Choleric people showed the best result in the dynamic balance test – 6,21±0,1 s, reliable differences ($p\leq0,05$) were observed in comparison with the group of sanguine and melancholic people.

Phlegmatic people in this test demonstrated a stable tendency to improve dynamic balance indicators from 8,57±2,5 s to 6,7±2,3 s. When comparing the results of testing strength endurance and flexibility of female students with different types of temperament, homogeneity of the groups was revealed.

However, the best result in the strength test was demonstrated by the phlegmatic group (108,3±25,6 sec), and the leaders in the result before the experiment – the melancholics, on the contrary, turned out to have the lowest indicator of 87,8±18,4 sec. In the test for flexibility of the spine and mobility of the hip joints, the best result was shown by the phlegmatics: 62,9±18,3 cm.

Conclusions. Thus, as a result of the conducted research, differences in the indicators of special physical fitness of female students with different types of temperament were revealed. Accordingly, taking into account temperament during health aerobics classes will allow more effective construction of the educational and training process in physical education, helping the trainer-teacher to expand the components of the individual approach and determine the methods of working with each student.

References

1. Diyanova Z.V., Shchegoleva T.M., Frolova O.P. Obshchaya i eksperimentalnaya psikhologiya. Practice: study guide for universities. O.P. Frolova [ed.]. 2nd ed., corr., sup. Moscow: Yurayt publ., 2024. 402 p.
2. Inozemtseva E.S., Vytnova A.E., Cherepanova L.A. Step-aerobika kak sredstvo razvitiya koordinatsionnykh sposobnostey studentok. Nauka sovremennosti: problemy i resheniya. Collection of scientific articles. Part. 4. Moscow: Pero publ., 2021. pp. 17-21.
3. Cherepanova L.A., Zemlyakova Z.S., Inozemtseva E.S. Osobennosti temperamenta i spetsialnaya fizicheskaya podgotovlennost studentok, uchastvuyushchikh v sportivno-massovykh meropriyatiyakh. Teoreticheskiy i prakticheskiy potentsial sovremennoy nauki. Collection of scientific articles. Part. 8. Moscow: Pero publ., 2020. pp. 64-70.

Effective pedagogical means of preventing posture disorders

UDC 373.5

A.S. Egorov[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: natalitomsk@list.ru

Received by the editorial office on 05.06.2024

Abstract

Objective of the study was to identify optimal means of preventing posture disorders in students.

Methods and structure of the study. Anthropometric measurements, posture measurements, and a survey of 110 first-year students of the Tomsk State University main medical group were conducted.

Results and conclusions. According to the results of measurements, 60% of students had reversible initial stage posture disorders and 80% had deviations from the norm of body weight. The article considers various technologies for preventing posture disorders, and also identifies optimal means for preventing posture disorders in student youth in the process of physical education. A new pedagogical technology for preventing posture disorders in students is proposed.

Keywords: *prevention of posture disorders, students, anthropometric measurements, posture measurements, questionnaires, pedagogical technology.*

Introduction. In the last decade, there has been a negative trend in the health of student youth. According to scientific research, up to 80% of first-year students have various functional deviations or various chronic pathologies. One of the most common deviations is posture disorders. Due to the high rate of development of information technologies, actively used in the learning process both in higher education institutions and schools, it leads to a decrease in physical activity. The use of various gadgets is dictated by both educational activities and dependence on social networks and computer games. All this is accompanied by a sedentary lifestyle and are negative factors leading to posture disorders [6, 7].

Objective of the study was to determine the optimal means of preventing posture disorders in students.

Methods and structure of the research. Anthropometric measurements, posture measurements, and a questionnaire survey of 110 first-year students of the Tomsk State University main medical group were conducted. 60% were found to have posture disorders of various nature at the pre-pathology stage, 80% were underweight. The survey results showed that only 10% of students with posture disorders were aware of their problem.

Results of the study and discussion. The research method was the analysis of literary sources on the study of prevention and correction of posture disorders for the purpose of further development and experimental substantiation of pedagogical technology for the prevention of students' posture in the context of the curriculum of higher education institutions.

It is well known that physical exercises are one of the most effective means of prevention and correction of posture disorders. However, existing methods are implemented mainly in groups of therapeutic physical education and special medical groups with students with pathological disorders of the musculoskeletal system. The conducted studies determined that students with posture disorders of various stages most often have a deviation of body weight from the norm, as a rule, this deviation is associated with insufficient muscle strength to maintain the musculoskeletal system in an optimal position.

Researcher S.E. Volozhanin in his pedagogical experiment used basic athletic exercises (squats with a barbell, deadlift, all standing presses). When using these means, attention was focused on eliminating the method of extreme efforts, and the calculation of the body mass index was used to assess body proportions, harmonious development and compliance with the height of the body and weight of the subjects. The experiment included the use of training complexes composed of well-known exercises with and without weights, used in strength sports, as well as exercises to improve muscle elasticity and exercises with elements of hatha yoga gymnastics. The results of the experiment showed the effectiveness of the means used [4].

Researcher V.A. Kashuba developed a technology for preventing posture disorders, in which students were divided into levels of biogeometric profile of posture based on 11 indicators in the frontal and sagittal planes. The author used an individual approach in his technology and took into account the characteristics of the students' physical fitness. The developed technology consisted of three stages: preparatory, main and supporting. The general structure of the classes used a block principle for constructing classes, on the basis of which four blocks of target orientation were identified: athletic gymnastics, pilates, stretching, ideomotor training. To solve the problems of preventing the biogeometric profile of students' posture, strength-oriented exercises were used to strengthen the muscular and skeletal systems; special static-dynamic exercises in combination with breathing exercises; special exercises in which muscle tension is combined with subsequent relaxation and stretching. The conducted pedagogical experiment confirmed the effectiveness of this technology [5]. Researcher E.A. Babydov based his method of correcting kypholordotic posture of young men aged 25-35 in fitness centers on the following means:

- strength exercises with weights, performed by a repeated method with a differentiated range and degree of effort when acting on muscles with distant attachment points and reduced traction force and acting on muscles with close attachment points, taking into account the functional state of the muscles of those involved;

- a set of special exercises (stretching), aimed at improving flexibility, developing joint mobility and elasticity of the extensor muscles of the lumbar spine, flexor muscles of the thoracic spine;

- aerobic training on a horizontal exercise bike with a backrest while maintaining a neutral position of the spine.

In his method, the author distinguishes three stages: 1. Adaptation load 12-14 repetitions 50-60% 1RM. 2. Corrective-developing muscles with close points 12-14 repetitions 50-60% 1RM, and for muscles with reduced traction force in the range of 6-8 repetitions 70-80% 1RM, which will contribute to their strengthening, muscle tissue growth and an increase in traction force. 3. Supporting. The method of correction of kypholordotic posture had a more pronounced corrective effect, compared to the correction method based on Pilates exercises [1, 2, 3]. The analyzed sources describe methods and technologies primarily aimed at an individual approach to the correction and prevention of posture disorders. Effective means for the prevention and correction of posture disorders have been identified. However, the use of an individual approach in the process of physical education of students is a rather complex task and does not have the ability to cover a large number of students.

Conclusions. Based on the analysis of the studied material, we proposed a new pedagogical technology for the prevention of posture disorders for first-year students using the previously described means and methods, but with a certain correction of the content of exercise complexes, their volume and intensity of physical activity, allowing for classes to be held for different groups of students without taking into account their health status and aimed not only at preventing posture disorders, but also at implementing one of the main tasks of physical education aimed at developing the physical qualities of students. Which would allow for effective classes with the main health group. The results of further research will be presented in the following publications.

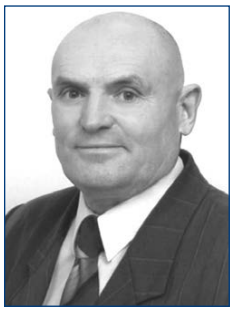
References

1. Babydov E.A. Uprazhneniya s otyagoshcheniyami i stretching kak sredstva korrektsii kifolordoticheskoy osanki u lits molodogo vozrasta. Obrazovaniye. Nauka. Nauchnyye kadry. 2015. No. 1. pp. 174-176.
2. Babydov E.A., Tkachenko S.A., Rybakov V.A. Vliyaniye kompleksnoy metodiki uprazhneniy s otyagoshcheniyami na pokazateli boli po oprosniku SF-36. Chelovek. Sport. Meditsina. 2022. Vol. 22. No. S1. pp. 91-96.

3. Babydov E.A. Kompleksnaya metodika ispolzovaniya fizicheskikh uprazhneniy dlya korrektsii kifolordoticheskoy osanki molodykh muzhchin. PhD diss. abstract. Moscow, 2024. 24 p.
4. Volozhanin S.E. Atletizm kak sredstvo profilaktiki i ispravleniya skolioza 1 i 2 stepeney u studentov v protsesse fizicheskogo vospitaniya v vuze. Obrazovaniye lichnosti. 2019. No. 1. pp. 127- 136.
5. Kashuba V.A., Dudko M.V. Tekhnologii profilaktiki narusheniy osanki studentov v protsesse fizicheskogo vospitaniya. Nauka i sport: sovremennyye tendentsii. 2016. No. 2. pp. 24-30.
6. Momot T.G., Sharaykina E.Yu., Novikova L.I., Stepanova S.I. Vyyavleniye, profilaktika i korrektsiya narusheniy osanki u studentov meditsinskogo uchilishcha. Meditsinskaya sestra. 2013. No. 7. pp. 47-48.
7. Pashkov A., Shipunov V. Vstrechayemost narusheniy osanki sredi studentov g. Barnaul. Deutsche Internationale Zeitschriftfür Zeitgenössische Wissenschaft. 2021. No. 9-1. pp. 30-32.

Physical fitness of first-year students: the role of living conditions

UDC 796.012.1



Dr. Hab., Professor **V.G. Shilko**[1]
PhD **N.L. Guseva**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: vshilko@mail.ru

Received by the editorial office on 02.07.2024

Abstract

Objective of the study was to identify the dynamics of physical fitness indicators and health status of students over the period from the beginning of the pandemic to the present.

Methods and structure of the study. A comparative analysis of indicators of physical fitness and health status of first-year students from 23 faculties and institutes of National Research TSU was carried out in the pre-pandemic (2019), post-pandemic (2022) periods of life and two years after the end of the pandemic (2023).

Results and conclusions. A comparative analysis of the physical fitness of firstyear students in three different periods of study in terms of volume and intensity of physical activity showed a clear, reliable ($p<0,05$) decrease in the indicators of physical quality development (in men and women) in 2022-2023 compared to 2019, which indicates an insufficient level of physical activity applied using physical exercises. The authors conclude that one of the main tasks of physical education should be aimed at developing students' motivation to increase physical activity.

Keywords: *physical fitness, health status, students, pandemic.*

Introduction. The period 2019-2023 was marked by major changes in the format of educational activities associated with the pandemic and its end - this is the introduction, along with traditional, distance and blended forms of learning. These changes significantly affected the level of physical activity of university students, and also affected their psychophysical condition. In this regard, it seems relevant to track changes in the indicators of physical fitness and functional state of student youth during the pandemic and post-pandemic periods. A comparative analysis allows us to identify effective means of physical activity in improving the health of students.

Objective of the study was to track the changes in the physical fitness and health indicators of students from the start of the pandemic to the present day. Methods and structure of the study. The sociological study involved first-year students from 23 faculties and institutes of TSU from three different periods of study – about 500 people. Control tests were conducted within the framework of the disciplines «Physical Education and Sports» and «Elective Disciplines in Physical Education and Sports» in 2019 before the start of the pandemic, in 2022 after its end and 2023, after returning to face-to-face education, according to the results of which the level of physical fitness of students (men and women) was assessed. In addition, data on the health status of students enrolled based on the results of medical examinations in the SMG and MFC were also recorded during the three previously designated periods of study.

For an objective assessment of the psychophysical state of students (men and women), the analysis was divided into three positions: the first (2019-2022), the second (2022-2023) and the third (2019-2023).

Results of the study and discussion. Analyzing the results of testing the physical fitness of students after the end of the pandemic, we obtained the following data: the level of strength development among students of 2022 (average statistical values) compared to their predecessors of 2019 was lower by 14,1%, speed – by 8,7%, endurance – by 3,4%, speed-strength qualities – by 5,6%. The

highest percentage of detraining was noted in the development of flexibility - 30%. As the research materials confirm, in none of the indicators of physical development did the students of 2022 have any advantages over their earlier predecessors, the pre-pandemic period of in-person education. In almost all indicators, the development of physical qualities of female students who studied before the pandemic, compared to their colleagues who began practical physical exercises after its end, was even more impressive compared to male students, namely: in the development of speed, the indicators of first-year female students of 2022 were lower than their classmates of 2019 by 8,5%, endurance and strength – by 21% in both cases, speed-strength qualities – by 8,2%. The largest decrease in the representatives of the «weaker sex» was noted in the development of flexibility – and 34,5%. In addition to the above, it should be noted that in order to intensify the physical activity of students and improve their physical condition, the TSU Physical Culture and Sports Complex has developed a new physical education curriculum, which involves the modernization of the educational and training process in the areas of «Physical Education and Sports», «Elective disciplines in physical education and sports» based on the formation of a target package of motivational incentives that contribute to increasing the physical activity of student youth to the level of the physiological standard. This program has been introduced into the educational process since 2022 [2]. The second stage of the study involved analyzing the data obtained characterizing the levels of development of physical qualities of students (men and women) in 2022 and 2023, which would allow not only to give an objective assessment of the quality of the work done by the TSU Physical Culture and Sports Complex, but also to assess the effectiveness of the new curriculum and the attitude of students to the previously announced disciplines that are mandatory in the physical education system of higher education.

In this regard, a comparative analysis of the physical fitness indicators of students of the class of 2023, compared to 2022, is of great interest. For men, almost all indicators of physical development in 2023 turned out to be better than for students of 2022, namely: in 100 m running, standing long jump, flexibility and pull-ups on the bar, the advantage was (5% - 0,34% - 41,6% - 9,3%), respectively. And only in the 3000 m run, the indicator of 2022 was better by 5.66%, compared to the achievements of men of the class of 2023. For women, the advantage in the indicators of similar compared periods of study in all control exercises was higher among 1st year female students of the class of 2023. Moreover, if reliable differences were recorded in three indicators for men, then in all five indicators of physical quality development, women were significantly higher than their 2022 predecessors ($p>0,05$).

And finally, no less interesting were the changes in the indicators of physical fitness of students (men and women) that occurred in 2023, compared to the «pre-pandemic» period of study.

A comparative analysis of the achievements of 2023 students in most indicators (in 4 out of 5) for men and women turned out to be lower than the indicators of 2019 study. And only in the indicators of strength development was the advantage on the side of representatives of both sexes of the later period of study. At the same time, the changes in both groups of students in 2023 were significantly higher than those in 2019. Therefore, after two years of study in the previously announced disciplines, despite the significant modernization of the curriculum, it was still not possible to achieve the indicators of development of the physical qualities of students (men and women) in 2019.

In 2019, 37% of students successfully passed the established standards with grades of «4 and 5», and in 2022 their number decreased to 30%, but by the end of 2023 this figure was at the level of the pre-pandemic period of study – 36,6%. And finally, if in general out of the total number of students studying at NI TSU in the disciplines «Physical Education and Sports» and «Elective disciplines in Physical Education and Sports» in 2019-2022, 65 and 58% of students, respectively, successfully passed the established standards, then by 2023 this figure was significantly exceeded 74,9%. Comparative analysis of the results of medical examination of 1st-3rd year students in 2019, 2022 and 2023 training, based on the results of which the medical group was determined, confirm that the situation with the physical health of students has not changed for the better over the past four years. The medical examination indicators of 6 297 students of the 1st to 3rd years of study in 2019 are as follows: the number of exempted (chronic diseases) – 212 people (3,4%), exercise therapy – 532 people (8,4%), physical therapy – 1 107 people (17,6%), preparatory and main groups

(POG) – 44 446 people (70,6%), respectively. In 2022, out of 7 779 students covered by physical education, the number of exempted from physical exercise classes was 265 people. (3,4%), assigned to the exercise therapy group – 1128 people (14,5%), SMG – 1274 (16,4%), POG – 5112 (65,7%). In 2023, the health situation of students remained virtually unchanged: out of the total number (8303 people), 374 people were exempted from physical exercise classes (4,5%), exercise therapy – 1401 (16,86%), SMG – 1353 (16,28%), POG – 5175 (62,5%) [2].

Conclusions. A comparative analysis of the physical fitness of first-year students of three different periods of study in terms of volume and intensity of physical activity showed a clear, reliable ($p<0.05$) decrease in the indicators of physical quality development (in men and women) in 2022-2023, compared to 2019, which indicates, first of all, an insufficient level of physical activity applied using physical exercises. Therefore, taking into account the results of the study, at present, one of the main tasks of physical education at the university is to restore the physical fitness and health of students to the "pre-pandemic" level, since, unfortunately, this could not be done during the two-year period of study after the end of the pandemic. And this problem can be successfully solved only by forming the appropriate motivation in students. Moreover, the successful implementation of the main tasks of physical education, especially at the present time, is possible only under the condition of joint strengthening of the entire system of physical education of the Russian Federation, starting with pre-school organizations and institutions, comprehensive schools and ending with the system of higher professional education and other educational structures, where physical education and professional-applied physical training are compulsory disciplines.

References

1. Belyanicheva V.V. Formirovaniye motivatsii zanyatiy fizicheskoy kulturoy u studentov. Moscow: Fizicheskaya kultura i sport: integratsiya nauki i praktiki publ., 2009. 6 p.
2. Shilko V.G., Guseva N.L., Sharafeeva A.B. Vliyaniye faktora «obezdvizhennosti» na urovni fizicheskoy podgotovlennosti i sostoyaniye zdorov'ya studentov. Teoriya i praktika fizicheskoy kultury. 2023. No. 8. pp. 61-62.

The level of physical activity of preschoolers while they are in kindergarten during the summer

UDC 373.24

PhD, Associate Professor **V.S. Sosunovskiy**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: vadim14sergeevich@gmail.com

Received by the editorial office on 02.07.2024

Abstract

Objective of the study was to calculate the amount of physical activity engaged in by preschoolers during their time at a preschool facility during the summer and to compare it with the levels of activity observed in the fall, winter, and spring.

Methods and structure of the study. To gather data on the physical activity of preschoolers, the researchers employed the method of pedometry. The number of locomotives was calculated using the Yamasa Corp., Yamax DW-200 Sh 25 pedometer, which was manufactured in Tokyo, Japan. The study examined the pedometer data of 234 children, including 132 children aged 5-6 (70 girls, 62 boys) and 102 children aged 3-4 (46 girls, 56 boys).

Results and conclusions. Upon examining the data obtained through pedometry, it was observed that the level of physical activity among preschoolers during the summer was higher compared to the autumn, winter, and spring seasons. These findings provide valuable insights for the development of a more effective physical education and wellness program, taking into account the natural variations in children's physical activity throughout the year.

Keywords: *motor activity, physical culture and wellness process, preschool educational institution.*

Introduction. Over the past decades, we have seen a change in children's motor activity patterns, as they have become less likely to play outdoors due to a number of reasons: changing parental attitudes toward child safety, the influence of modern gadgets, etc. Therefore, modern parents, in order to avoid a deficit of motor activity in their children, offer them to attend various sports sections from preschool age [1, 3, 4, 5]. In this regard, the physical activity of modern children has changed its vector from independent, voluntary activities in the fresh air to structured, directive activities indoors. It is worth noting that this phenomenon is reflected not only in a decrease in the physical and functional indicators of children, but also often contradicts the basic provisions of preschool childhood, which is considered a unique period in the formation of a person's personality. Also, in organized joint motor activity, there is no element of the formation of the child's subjective position, because all motor activity is planned in advance and provided to the child by the teacher.

Objective of the study was to calculate the amount of physical activity engaged in by preschoolers during their time at a preschool facility during the summer and to compare it with the levels of activity observed in the fall, winter, and spring.

Methods and structure of the study. To collect information on the number of motor acts of preschool children, the pedometer method was used in the study. The number of locomotions was counted using a pedometer «Yamax DW-200 Sh 25» manufactured by Yamasa Corp., Tokyo, Japan. The study was conducted at 4-hour intervals in the morning and evening in accordance with the routine moments of individual age categories of children (from 9:00 to 13:00 hours, from 15:00 to 19:00 hours). The study analyzed the data from the pedometer of 234 children (132 children aged 5-6 years (70 girls, 62 boys), 102 children aged 3-4 years (46 girls, 56 boys).

Results of the study and discussion. Analyzing the results of the study presented in Table 1, it was found that the number of locomotions in children of all age categories of preschool age in the summer period increased significantly compared to the results in the autumn, winter and spring periods [2]. Thus, comparing the results of the volume of motor activity, we can conclude that in girls aged 5–6 years, the number of locomotions in the summer period compared to the autumn, winter and spring periods increased by an average of 1 535 motor acts, while the distance traveled increased by an average of 1,13 km. In boys aged 5–6 years, there is an increase in the number of locomotions by an average of 2 660 motor acts and the distance traveled by an average of 0,18 km (see table).

In girls aged 3–4, the number of motor acts during their stay in a preschool educational institution in the summer period increased by an average of 693 locomotions compared to the results obtained in the autumn, winter and spring periods, and the distance traveled on average was 2.39 km, which is 0.31 km more than in the previously noted periods. The results of boys aged 3–4 in testing aimed at identifying the number of motor acts showed that in the summer period the results increased by an average of 1248 locomotions. Also, analyzing the results of pedometry in boys of this age category, we can observe an increase in the distance traveled by an average of 0.78 km (Table 1). Next, we analyzed the results of the number of locomotions of girls aged 5–6 by time periods during the day. The data obtained show an increase in motor activity in the morning from 9:00 to 10:00, from 11:00 to 12:00 and in the evening from 18:00 to 19:00. These results are presented in a wave-like form, which indicates the periods and characteristics of children's motor activity during the day (Figure 1).

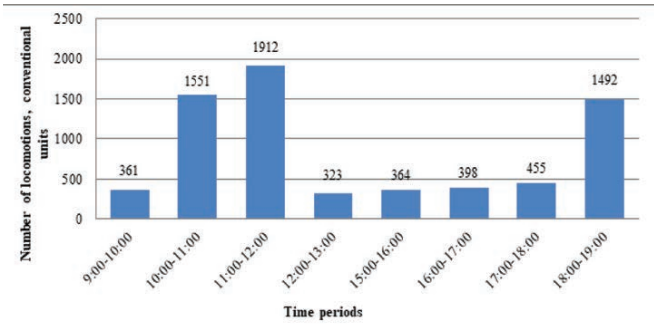


Figure 1. The number of motor acts of girls aged 5–6 years during their stay in kindergarten in the summer

We also associate these values with the fact that in the summer, educators meet children outside, continuing their walk on the preschool playground immediately after the first meal (breakfast). In preschool education practice, there are three periods of increased motor activity in children: morning (from 8:00 to 9:00), daytime (from 10:30 to 12:00), and evening (from 16:30 to 19:00). Figures 1 and 2 clearly show the daytime period of increased motor activity. The time period from 10:00 to 12:00 in the summer is not limited by routine moments, children independently perform motor actions, while the time period from 11:00 to 12:00 for girls aged 5–6 is represented by 361 locomotions more on average, which confirms the periods of increased motor activity in preschool children. Analyzing the results of pedometry of boys aged 5–6 years during their stay in kindergarten in the summer, as well as in girls of this age, we can observe an increase in the number of locomotions compared to other times of the year.

From data in Figure 2 shows that in boys there are two significant periods of increasing the volume of motor actions. The first period is 2 hours long, during this period from 10:00 to 11:00 the number of locomotions in boys aged 5–6 is 1825 motor acts, while from 11:00 to 12:00 the number of locomo-

The volume of physical activity of preschoolers during their stay in preschool educational institutions

Indicators	Girls 5-6 years old	Boys 5-6 years old	Girls 3-4 years old	Boys 3-4 years old
	$\bar{X} \pm \sigma$	$\bar{X} \pm \sigma$	$\bar{X} \pm \sigma$	$\bar{X} \pm \sigma$
Summer time period				
Number of locomotions, conditional units	6856±1215	7981±1114	4653±1024	5512±1069
Distance traveled, km	3,35±0,62	4,05±0,96	2,39±0,61	2,92±0,58
Autumn, winter and spring periods of time				
Number of locomotions, conditional units	4482±1036	6090±978	3960±963	4264±952
Distance traveled, km	2,22±0,54	3,18±0,87	2,08±0,57	2,14±0,61

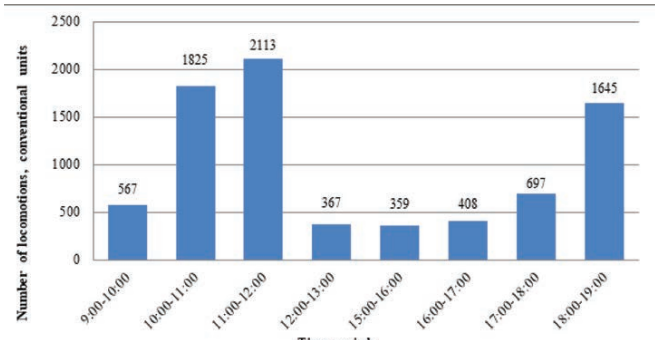


Figure 2. The number of motor acts of boys aged 5–6 years during their stay in kindergarten in the summer

tions is 2113 motor acts. It is worth noting that the indicators of children's motor activity should be affected by the process of fatigue during the period of their motor activity, thereby reducing the number of locomotions, but in this case we observe an increase in the number of locomotions by 288 conventional units. We associate these indicators with the process of running in.

Conclusions. In the process of analyzing the obtained results of pedometry, an increase in the volume of motor activity of preschool children in the summer was revealed compared to the autumn, winter and spring periods of time. The obtained research results will allow us to design the physical education and health process more effectively, in accordance with the natural changes in the child's motor activity in various time frames. Based on the results of the study, it is planned to develop recommendations on the optimal time for performing joint organized activities aimed at the cognitive, physical, artistic and aesthetic, speech development of preschoolers within the framework of the regime moments of the educational program of the preschool institution.

References

1. Dvorkina N.I., Lubysheva L.I., Akhmetov S.M. Protsessualnaya model sistemy formirovaniya bazovoy lichnostnoy fizicheskoy kultury detey doshkolnogo vozrasta. Teoriya i praktika fizicheskoy kultury. 2016. No. 1. pp. 46-49.
2. Sosunovskiy V.S. Dvigatelnaya aktivnost detey vo vremya prebyvaniya v doshkolnom obrazovatelnom uchrezhdenii. Teoriya i praktika fizicheskoy kultury. 2022. No. 12. pp. 78-80.
3. Sosunovskiy V.S., Zagrevskaya A.I., Shelgacheva A.M., Akaneeva E.A. Stanovleniye subyektnosti doshkolnika vo vremya fizkulturno-sportivnoy deyatelnosti. Teoriya i praktika fizicheskoy kultury. 2023. No. 8. pp. 102-104.
4. Denova-Gutierrez E. et all. Overview of systematic reviews of health interventions for the prevention and treatment of overweight and obesity in children. Nutrients. 2023. No. 15 (3). 773 p.
5. Gutierrez E.D. et all. Overview of systematic reviews of health interventions that aim to prevent and treat overweight and obesity among. Syst. Rev. 2022. No. 11. 168 p.

Physical activity as a basis for the health of students of a pedagogical university

UDC 378.17

PhD, Associate Professor **N.A. Koshkina**[1]
G.A. Popova[1]
PhD, Associate Professor **E.G. Shushkanova**[2]
[1]Vyatka State University, Kirov
[2]Kirov State Medical University, Kirov

Corresponding author: usr11894@vyatsu.ru

Received by the editorial office on 20.06.2024

Abstract

Objective of the study was to evaluation of students' physical activity and its correlation with various aspects of a healthy lifestyle.

Methods and structure of the study. One hundred and fifty students in their first year of study in the pedagogical program at Vyatka State University in Kirov participated in the experiment. To evaluate the elements of a healthy lifestyle, we employed the questionnaire «Prozozh». The level of activity of the participants was assessed using the questions from the SAN methodology. The vitality and strength indices were calculated using standard methods. The statistical analysis was conducted using the Jamovi software (version 1.6). The correlation between the components of a healthy lifestyle and the activity scale was determined using the Spearman's rank correlation coefficient.

Results and conclusions. The findings demonstrate the average level of healthy lifestyle components among first-year students. A responsible approach to health was observed in 50% of the participants. The majority of respondents (66%) do not engage in regular physical activity or exercise. Insufficient sleep was reported by 59% of the participants, which may have a negative impact on their performance and overall well-being. A positive correlation has been established between the indicators of physical activity and the SAN activity scale: the higher the physical activity score, the higher the overall activity score, and vice versa (r=0,161; p=0,049). Therefore, increasing physical activity and implementing educational initiatives to promote healthy lifestyle habits are crucial for maintaining the health of students.

Keywords: *health, healthy lifestyle, physical activity, pedagogical university, students.*

Introduction. Currently, the issues of maintaining health and involving students in a healthy lifestyle (HLS) are becoming more and more relevant. Research has shown that the reasons for the decline in health indicators during university studies are changes in the usual behavioral stereotype, deterioration in the quality of nutrition, reduction in physical activity, combining study with work, often at night. In addition, one of the significant factors influencing the maintenance of health is sufficient physical activity. Prolonged sitting increases the static load on the muscles and leads to changes in the musculoskeletal system and functional systems, the development of physical inactivity. Data from empirical studies of health indicators among students show that 50-70% of students have a lack of physical activity [1, 2]. The issues of the relationship between a healthy lifestyle and physical activity of students remain relevant today.

Objective of the study was to evaluation of students' physical activity and its correlation with various aspects of a healthy lifestyle.

Methods and structure of the study. The experiment was conducted at Vyatka State University (VyatSU) in Kirov with first-year students majoring in pedagogy (n=150, average age 18,52±0,05 years). The components of a healthy lifestyle (HLS), including physical activity, were assessed using the Healthy Lifestyle Profile (Healthy Lifestyle Profile) questionnaire

adapted by M.D. Petrash for a Russian sample [5]. The questionnaire includes 52 questions-statements grouped into six scales (Table 1). The respondents expressed their attitude to the proposed statements of the questionnaire on a scale from 1 to 4 points. To determine the degree of activity of the subjects, the following questions from the SAN methodology were used: well-being, activity, mood, where the activity scale was assessed, containing 10 pairs of opposite characteristics showing the degree of expression of the respondent's activity state from 1 to 7 points (the norm is 5,0-5,5 points). Measurement of vital capacity of the lungs (VC, ml) and muscle strength of the dominant hand (MS, kg) were carried out using standard methods, vital (VI, ml/kg) and strength (SI, %) indices were calculated.

The data analysis included descriptive statistics, which allowed us to assess the level of expression of the components of a healthy lifestyle in the general sample of respondents. To identify the relationship between the components of a healthy lifestyle and the activity scale, the Spearman rank correlation coefficient was used. Statistical data analysis was performed using the Jamovi program (Version 1.6).

Results of the study and discussion. The analysis of the obtained results shows the average level of formation of the components of a healthy lifestyle from the total sample of respondents. Comparative indicators of the formation of the components of a healthy lifestyle among students are presented in Table 1 (according to the data of the questionnaire «ProZHOZH»).

Based on the obtained results, the greatest expression of average values is noted among the overwhelming majority of students among the scales «Interpersonal Relationships» and «Internal Growth» and is 83,8% and 77,3% of the total number of respondents, respectively. Less developed among the respondents are the levels on the scales characterizing the stress resistance of the individual (63,9%), the students' attitude to maintaining individual health (56.3%), the necessary physical activity (57,1%) and nutrition (57,1%), which is 1,3-1,5 times less compared to the indicators of the scales of the cognitive and emotional component of a healthy lifestyle from the total number of respondents. In connection with the above, more than 40% of first-year students in general have a decrease in physical activity, value attitude to health and an increased level of stress, which confirms the relevance of the issue we are studying. Thus, the analysis of the «Responsibility for Health» scale revealed that only 50% of respondents are able to take a responsible attitude towards their health. At the same time, when acute symptoms of diseases appear, a significant part of respondents (89.3%) consider it important to seek qualified medical help, which is significantly higher than the share of students who systematically seek medical help - 45% of the total number of respondents. Less than half of the respondents (42%) are interested in knowledge about preventing various diseases, ways of maintaining and improving health, receive information from different sources (24%), attend special health programs (4,7%). Our data are consistent with the studies of N.S. Zhuravskaya et al. [3], confirming the low responsibility of students for their health. The survey data on the assessment of physical activity show that about half of the respondents (47,3%) train without taking into account the functional and individual characteristics of the body. The majority of respondents (60%) deny or hold a negative opinion about the need to perform increased physical activity, while 40% of respondents train at least 3 times a week. Only one third of respondents (34%) consider it necessary to actively organize personal free time with elements of physical activity (swimming, dancing, cycling, etc.).

A significant majority (80%) of respondents from the total number of respondents confirm that the presence of special individual systematic physical activity is not the main criterion for maintaining health and maintaining a healthy lifestyle.

Despite the systematic organization of the training process and sports, only the smallest part of re-

Table 1. Average indicators of the formation of the components of the "Healthy Lifestyle Profile" of 1st-year students of Vyatka State University

Indicator	Average (M±m)	Standard deviation (SD)
Responsibility for health	2,253±0,030	0,522
Physical activity	2,282±0,037	0,635
Nutrition	2,285±0,029	0,499
Internal growth	3,091±0,029	0,501
Interpersonal relationships	3,353±0,028	0,490
Stress management	2,554±0,031	0,545
General scale	2,660±0,021	0,363

Table 2. Average indicators of PI and LI of 1st year students of Vyatka State University

Indicators	Young men (n=17) M±m	Standard indicators	Girls (n=133) M±m	Standard indicators
Power index (PI, %)	49,0±1,01	65-75	38,9±0,89	50-60
Life index (LI, ml/kg)	56,1±2,12	60-65	45,6±2,74	50-55

spondents (15%) measure their pulse during physical exercise as a criterion for assessing the response of the cardiovascular system to physical activity, considering this important for monitoring their health. Insufficient physical activity of students (up to 58% of respondents) is shown in the works of domestic and foreign authors, which is consistent with the data of our studies [4].

The scale of stress resistance of students showed that the majority of respondents (78%) understand the importance of alternating mental and physical activity, which is the main condition for restoring the body's performance. At the same time, 59% of respondents have insufficient sleep duration, which indicates a lack of understanding of the value of full physiological sleep for maintaining a healthy state of the body. Research by L.I. Chufarova [6] confirms the disruption of students' sleep patterns, reducing their duration as one of the factors maintaining mental and physical health.

The assessment of the level of activity of the subjects using the SAN method showed an average level of general vital activity and amounted to 4,44 ± 0,10 out of 7 maximum points. When comparing the indicators of physical activity «ProZHOZH» and the SAN activity scale, a significant positive relationship was established (r = 0,161; p = 0,049). The higher the indicator of physical activity, the higher the indicator of general activity and vice versa.

The data obtained confirm the interdependence of the necessary systematic physical activity and the general activity of the student, which contributes to the overall strengthening of health, a positive emotional background of students, and creates a favorable environment for maintaining a healthy lifestyle. With regard to the remaining indicators of the questionnaire «ProZHOZH Profile» and the SAN activity scale, no significant relationships were established.

An assessment of the muscle strength of the dominant hand and the vital capacity of the lungs showed a decrease in the values of the strength and vital indices relative to the age norm, which is possibly associated with insufficient motor activity and leads to weak development of the respiratory muscles and hand muscles of the subjects (Table 2).

Conclusions. The conducted studies showed an average level of formation of healthy lifestyle components among student teachers, the absence of responsibility for their health among the overwhelming majority and insufficient physical activity. Many students underestimate the importance of physical exercise and sports activities as a criterion for maintaining and strengthening health, have reduced values of strength and vital indices, and insufficient sleep duration. To maintain and preserve the health of students, increasing physical activity and conducting targeted educational work on the formation of a healthy lifestyle is an integral part of the educational and educational activities of the university.

References

1. Antonova A.A., Yamanova G.A. Zdorovyy obraz zhizni i zdorovye sovremennykh studentov. Mezhdunarodnyy nauchno-issledovatelskiy zhurnal. 2022. No. 7 (121). Part. 2. pp. 7-9.
2. Gairbekov M.M., Bazaeva F.U. Problemy formirovaniya potrebnosti v zdorovom obraze zhizni u studencheskoy molodozhi. Mir nauki, kultury, obrazovaniya. 2019. No. 5 (78). pp. 209-211.
3. Zhuravskaya N.S., Alenitskaya M.V., Yanovich V.A. K voprosu o formirovanii vospriyatiya zdorovogo obraza zhizni studencheskoy molodezhi (na primere studentov Vladivostokskikh vuzov). Zdorovye naseleniya i sreda obitaniya. 2022. No. 12. Vol. 30. pp. 37-44.
4. Maltsev V.P., Govorukhina A.A., Lozhkina-Gametskaya N.I. Kharakteristika komponentov zdorovogo obraza zhizni studentov pervokursnikov pedagogicheskogo vuza v kontekste lichnostnykh osobennostey. Azimut nauchnykh issledovaniy: pedagogika i psikhologiya. 2021. Vol. 10. No. 4 (37). pp. 348-351.
5. Petrash M.D., Strizhitskaya O.Yu., Murtazina I.R. Validizatsiya oprosnika «Profil zdorovogo obraza zhizni» na rossiyskoy vyborke. Konsultativnaya psikhologiya i psikhoterapiya. 2018. No. 3. Vol. 26. pp. 164-190.
6. Chufarova L.I., Tetkina E.A. Psikhologicheskoye otnosheniye studentov pedagogicheskogo vuza k fizicheskoy kulture i zdorovomu obrazu zhizni. Nauka-2020, publ. 2023. No. 6 (67). pp. 58-65.

Student lifestyle: physical activity and health

UDC 796.011.3:378.4

M.S. Lim[1]
Dr. Hab., Professor **V.G. Shilko**[1]
Postgraduate student **D.S. Kim**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: vshilko@mail.ru

Received by the editorial office on 12.07.2024

Abstract

Objective of the study was to determine the dynamics of interests and attitudes of student youth towards physical education, sports style and a healthy lifestyle over the past decade.

Methods and structure of the study. The presented work presents data from sociological surveys conducted among students of the TSU Research Institute between 2013 and 2023. The aim of these surveys was to study their attitudes towards a healthy lifestyle, physical culture, and sports.

Results and conclusions. The examination allowed us to discern alterations in the preferences and requirements of students regarding participation in various sports and physical activities, and also to evaluate the significance of physical exercise in enhancing the health and physical condition of students in the two contrasting timeframes.

Keywords: *dynamics of interests and relationships, physical culture and sports lifestyle, importance of physical exercises.*

Introduction. In the last decade, quite a lot of scientific research has been devoted to physical education and sports, in the context of the formation of the PESL and a healthy lifestyle of student youth, which are considered as the main means of solving the urgent problem of increasing the physical activity of students to the level of the physiological standard necessary to ensure all processes of their life [1, 2].

Objective of the study was to determine the dynamics of interests and attitudes of student youth towards physical education, sports style and a healthy lifestyle over the past decade.

Methods and structure of the study. At the preliminary stages of the study, the structure and content of two areas of physical activity were studied, and then sociological surveys were conducted to study the attitude of TSU students to their own health, healthy lifestyle and social life, as well as the need and importance of physical exercise in their daily lives and future professional activities and their changes over 10 years. The 2023 study involved 150 1st-4th-year students from five TSU institutes and faculties. The age range of respondents was as follows: 17-20 years (80,7% of respondents), 21-22 years (12,3%), 23-25 years (7%), including 54,4% women and 45,6% men. After receiving and processing the research materials, a comparative analysis of the results of a similar survey in 2013 was carried out, the statistical data of which had unreliable deviations, both with a plus and minus sign. Similar monitoring has been conducted at TSU annually for over 20 years [3].

Results of the study and discussion. Studying students' attitudes towards a healthy lifestyle and PESL and factors of multidirectional influence on their formation is one of the important problems of modern pedagogical science [3, 4].

The level of self-assessment of the health status of TSU students, according to the results of surveys of two time periods in both cases, is characterized by the assessment of «good» (70,6 in 2013 and 73,7% in 2023), which corresponds to objective indicators on average for the region, which are determined annually through mandatory medical testing of students. The survey results showed that over

the past decade, young people have become more aware of the need to strengthen and maintain health and its importance in future professional activities – this is confirmed by the results of the 2023 studies – 78,9% and 58,7% in 2013. Moreover, if in 2013, in the ranking of especially significant activities necessary to ensure the life processes of students, health maintenance occupied 3-4 positions, then according to the results of the 2023 survey, it moved to the first two positions. In our opinion, the increase in the importance of strengthening and maintaining health is caused by objective reasons, since in the indicators of the health of student youth in the last decade, a fairly stable negative trend has been maintained.

In most responses to the question about who plays the leading role in forming a caring attitude towards one's health as a person grows older, the opinion of respondents has remained virtually unchanged over the past decade (51,6% and 50,9% in 2013 and 2023, respectively). Just like ten years ago, students are confident that a positive attitude towards one's health should be formed by social institutions, namely the family, preschool organizations, comprehensive schools, the higher education system, etc. Unfortunately, a fairly large percentage of respondents indicated the main reason for the need to take care of their health only when they had clear signs of its deterioration (15,6% and 19,3% of respondents in 2013 and 2023, respectively).

In this list of the main reasons, unfortunately, the use of physical exercise as a means of strengthening health and physical development occupied only the 8th position in 2013, moving to the 6th in 2023, which still indicates the lack of relevant competencies, and most importantly, the motivation of students to regularly engage in various areas of physical education and sports activities.

The majority of students indicated that no actions to maintain health guarantee its good condition, since to a large extent its level depends on hereditary factors and the impact of bad habits (smoking, drinking alcohol, drugs, etc.) – about 42,3 and 40,4% of responses in 2013 and 2023, respectively.

Nevertheless, among the important arguments that contribute to strengthening physical health, respondents rated the importance and necessity of physical exercise quite highly (33,6% in 2013 and 38,6% of responses in 2023) – this is the 2nd position in the ratings of positive factors in importance, after the «balanced diet» factor, and it has not changed over the past decade. In the list of the most significant disciplines necessary for obtaining knowledge about a healthy lifestyle, as well as acquiring practical skills and abilities in physical education and sports activities, as ten years ago, the following were noted: human physiology, sports medicine, psychological foundations of health, etc., which students rated especially highly (48,8% of respondents in 2013). In the results of the answer to the previously posed question, 54,4% of students in 2023 added to the previously listed disciplines the need to obtain methodological and practical knowledge and skills for organizing independent physical exercise classes.

Despite their relatively young age, students are still concerned about the issues of rational nutrition, as well as its quality (30.1% of respondents in 2013), the requirements for which have increased significantly over the past decade (35.8% in 2023) - this suggests that students are still quite aware of the need for high-quality nutrition as a factor determining health, as well as optimal mental and physical performance.

Research materials confirm the positive dynamics of increasing interest in the need to acquire knowledge about physical education and sports (12,3% in 2013 and 28,6% in 2023), characterizing the increasing level of their importance and the need for their presence in the daily lives of respondents.

Despite the insufficient level of daily motor-muscular activity in everyday life, students, like ten years ago, highly appreciated the need to engage in physical education and sports lifestyle (48,6% of respondents in 2013 and 56,1% in 2023), as an effective means of strengthening health and increasing their physical fitness. Despite the fact that the majority of students still have a low demand for knowledge about a healthy lifestyle, physical education and sports after 10 years, in response to the question about the need to use physical exercises in everyday life, the overwhelming majority of them answered in the affirmative (80,5% and 91,2% in the 2013 and 2023 surveys, respectively).

In recent years, students' physical education and sports interests have changed significantly. The results of the responses to the questionnaire question, in which students of two time periods were asked to name the types of sports they would like to do in order to join the Healthy Lifestyle and the Social Lifestyle Fund at TSU, have undergone signifi-

cant changes. Thus, if the majority of respondents in 2013 preferred traditional types such as athletics, gymnastics, aerobics, dance exercises (61,4%), as well as health running (29,8%), sports games and strength exercises (28,1% each), then more than half of the students in 2023 would prefer to engage mainly in «new» types of sports and physical activity, such as eSports, aqua aerobics, Jumping fitness (training on trampolines), phygital, airsoft, breaking, flag football, lacrosse, squash, etc. Of the traditional types, over time, not only have they not lost their significance, but only strength exercises have become more in demand, both among male students (45,4%) and female students (34,6%). Unfortunately, in this regard, it must be noted that all wishes in the direction of changing the curriculum and filling it with new types of sports and physical activity are currently practically impossible due to limited resource provision and the lack of appropriate (previously listed types of physical education and sports activities) pedagogical technologies.

Conclusions. Analyzing the research materials of two time periods of the life of students of TSU, it can be argued that in recent years, despite the spread of various health systems in society, the physical education and sports style and healthy lifestyle of student youth are becoming increasingly popular.

The survey results showed that over the past decade, young people have become more aware of the need to strengthen and maintain health and its importance in future professional activities. This is confirmed by the health importance rating in the 2023 study materials (1-2 positions).

Currently, among students, although weakly expressed, but still a positive trend in the need to acquire knowledge about a healthy lifestyle and FSSZH, physical education and sports is noted, although its level after 10 years remains low.

Of the responses received, in our opinion, more important are the results of monitoring the dynamics of students' physical education and sports interests over the past 10 years, which have changed significantly: there is a noticeable interest in modern sports and physical activity, and its traditional types are becoming less in demand. As before, strength exercises have not lost their importance for both sexes.

References

1. Vilenskiy M.Ya., Gorshkov A.G. Fizicheskaya kultura i zdorovyy obraz zhizni studenta. Moscow: Gardariki publ., 2003. 240 p.
2. Manzheley I.V. Stanovleniye fizkulturno-sportivnogo stilya zhizni studentov. Obrazovaniye i nauka. 2005. No. 4 (34). pp. 56-65.
3. Shilko V.G., Guseva N.L., Kapilevich L.V. Formirovaniye zdorovogo obraza zhizni studentov s ispolzovaniyem razlichnykh form fizkulturno-sportivnoy deyatelnosti. Vestnik Tomskogo universiteta. 2006. No. 292-2. pp. 401-403.

Circuit training method to improve strength endurance of cadets

UDC 796/799+ 378.14.015.62

Postgraduate student **A.A. Ignatov**[1]
[1]National Research Tomsk State University, Tomsk

Corresponding author: vshilko@mail.ru

Received by the editorial office on 05.07.2024

Abstract

Objective of the study was to assessment of the effectiveness of using the circuit training method in increasing the strength endurance of students at a military training center.

Methods and structure of the study. To achieve this goal, a pedagogical experiment was conducted on the basis of the Educational Training Center at National Research Tomsk State University, in which 16 5th year students (male, age 22-23 years) enrolled in the military training program for personnel officers took part. From their number, experimental and control groups of eight people each were formed. The experimental group worked out according to a training plan, which contained exercises performed using the circuit training method.

Research results and conclusions. The circuit training method can provide the greatest increase in results when used in exercises with a more pronounced strength component or external resistance factor - for example, in exercises with weights (squats with a barbell), since short series with a change in the muscle regions exposed to the impact provide better recovery between approaches bioenergetic systems responsible for the manifestation of strength abilities.

Keywords: *military training center, military applied physical training, strength endurance, circuit training method, cadets*

Introduction. The absence of a physical education system for students undergoing military training at the Military Training Center gives rise to a number of problems, the main one being the inability to ensure the proper level of development of professionally significant physical qualities, primarily strength and endurance. At the same time, given the specifics of combat and everyday activities of military personnel, these qualities are manifested in a complex manner, in the form of strength endurance, the development of which, given many years of pedagogical practice, is more effectively carried out on the basis of the use of the circuit training method [2].

Objective of the study was to assessment of the effectiveness of using the circuit training method in increasing the strength endurance of students at a military training center.

Methods and structure of the study. To achieve the set goal, a 10-week pedagogical experiment was conducted at the Military Training Center of the Tomsk State University. 16 5th-year students (male, aged 22-23) studying under the program of military training of personnel officers took part in the experiment. An experimental and a control group of 8 people each were formed from them. The experimental group (EG) trained according to the training plan, which contained exercises performed using the circuit training method. In the control group (CG), exercises were performed using the repeated method during training sessions on gymnastics and athletic training. The results of the experiment were assessed through pedagogical testing using control exercises set out in the Manual on Physical Training in the Armed Forces of the Russian Federation (Order of the Ministry of Defense of the Russian

Table 1. Example of a weekly training plan

Contents of the lesson	Methodological instructions
1. Box jumps	– Exercises are performed using a repeated method; – Intensity – non-maximum heavy weights (4-6 PM); – Volume – up to 20 lifts in total in each exercise (no more than 5-6 repetitions in a set). – Rest between sets – up to 3 min.
2. Pull-ups with additional weights	
3. Back squats	
4. Barbell bench press	
5. Barbell deadlift	
Uniform jogging at an easy pace for 10 minutes	
According to the circuit training plan	
1. Uniform jogging at an easy pace	– Duration – 10-15 min. – Heart rate – up to 130 bpm.
2. Special running and jumping exercises	– 1 series of 30-50 m for each exercise (10-15 series in total)
3. Cross or alternating running (with acceleration elements)	– Volume – up to 10 km; – Intensity: Heart rate – up to 150 bpm. (or more – on very rough terrain) – On slightly rough or flat terrain – free accelerations (fartlek)

Federation dated 20.04.2023 No. 230): pull-ups on a horizontal bar, bending, unbending arms, in a prone position (push-ups), and squats with a barbell (70 kg) [1].

Results of the study and discussion. The assessment of the physical fitness of military personnel is carried out using physical exercises of the control and verification complex (CVC). Depending on age groups and service purpose, the list of assessed physical qualities may vary, while the physical qualities of strength and endurance are mandatory for all categories of military personnel.

It is known that strength as a physical quality can manifest itself in the form of strength, speed-strength abilities and strength endurance. Combat and everyday activities of troops often involve prolonged physical activity of medium or moderately high intensity (for example, carrying heavy objects over long distances, loading or unloading property, engineering equipment of the area). That is why, according to the instructions on physical training in the Armed Forces, when assessing the development of strength qualities, mainly strength endurance tests are used, the results of which are determined by the number of repetitions in exercises performed with the weight of one's own body or with a fixed weight. For example, performing the control exercise «pull-ups on the bar» in the amount of 25 repetitions on average takes about one and a half minutes - such a duration of work is possible only under the condition of a high level of development, to a greater extent of strength endurance, than of strength abilities themselves [1].

Thus, the need to develop strength endurance of military personnel is professionally significant. And for its effective development, the method of circuit training is more effective, using specially selected exercises, the use of which will contribute not only to the development of the basic physical qualities of military personnel, but also to the improvement of their complex manifestations [3].

With regard to military-applied physical training of students of the Military Training Center, the method of circuit training has the following advantages:

1. High motor density allows for short, but sufficiently intensive classes, for example, as part of independent training of students, the time for which is allocated in accordance with the daily routine of the Military Training Center.

2. The possibility of effective application of relatively simple technical exercises due to the lack of possibility to use complex equipment (for example, in the field or at stadiums, gymnastics grounds, etc.).

3. Organization of group classes using the circuit method, which involves simultaneous performance of different exercises at "stations", is more appropriate for military groups, due to their large number.

Since strength endurance is a complex quality, classes in the process of experimental work were programmed to develop its key components: strength, strength endurance, stamina. Thus, the experimental group studied according to the developed plan, which assumed three training sessions per week with the following content:

1. Exercises aimed at developing strength and speed-strength abilities (repeated method);

2. Exercises aimed at developing strength endurance (circuit training method);

[1] Order of the Minister of Defense of the Russian Federation dated April 20, 2023 No. 230 «On approval of the Manual on physical training in the Armed Forces of the Russian Federation»

Table 2. Plan for constructing according to the principle of periodization with a linearly increasing intensity (expressed in the number of repetitions per approach) and a fixed total volume (60 pull-ups, 120 push-ups, 180 squats)

Week	Number of repetitions per set			Number of episodes	Total volume
	Pull-ups	Push-ups	Squats		
1	2	4	6	30	60 pull-ups 120 push-ups 180 squats
2	3	6	9	20	
3	4	8	12	15	
4	5	10	15	12	
5	6	12	18	10	
6	7	14	21	9	
7	8	16	24	8	
8	9	18	27	7	
9	10	20	30	6	
10	Sequential execution of each exercise (free number of repetitions and approaches)				

3. Cyclic aerobic exercises aimed at developing general endurance (uniform continuous and variable methods) (Table 1).

For the purposes of the pedagogical experiment, a series of exercises was used, which is a simplified version of the popular CrossFit complex «Murph», where there is no running component and additional weights, and strength exercises are performed in a circle [3].

In the control group, training sessions were also held three times a week, but in the second training session, the exercises were performed sequentially using the repeated method. The total volume was equal to the volume in the EG (in the free range of approaches and repetitions).

Testing the effectiveness of the developed technique was carried out at the ascertaining and control stages of the experiment. For this purpose, three control exercises were selected from the Manual on Physical Training in the Armed Forces of the Russian Federation, performed in the following sequence: No. 3 – «Pull-ups on the horizontal bar», No. 1 – «Bending and unbending arms in a lying position» and No. 16 – «Squats with a barbell on the shoulders».

Table 3 presents the testing results in the control and experimental groups, the comparison of which was carried out using the t-Student's criterion for independent samples. Differences were considered statistically significant at $p < 0,05$.

According to the testing results during the ascertaining experiment, no statistically significant differences were found in the level of development of strength endurance of the subjects of the experimental and control groups. The control experiment showed an increase in strength endurance indicators in both groups, while statistically significant differences were found only in two exercises: pull-ups on a horizontal bar and squats with a barbell.

Table 3. Test results in the control and experimental groups

Group	Pull-ups on the horizontal bar			Bending and unbending arms in a lying position			Squats with a barbell 70 kg		
	$x \pm m_x$	t	p	$x \pm m_x$	t	p	$x \pm m_x$	t	p
1. Ascertaining experiment									
EG	10,88 ± 1,30	0,23	0,83 (> 0,05)	36,00 ± 5,86	0,25	0,81 (> 0,05)	12,50 ± 1,77	0.41	0,69 (> 0,05)
KG	10,50 ± 1,01			33,88 ± 6,19			11,38 ± 2,04		
2. Control experiment									
EG	15,75 ± 1,43	**2,20**	**0,046 (< 0,05)**	42,50 ± 3,06	0.68	0,51 (> 0,05)	18,13 ± 1,52	**2.24**	**0,042 (<0,05)**
KG	12,13 ± 1,08			38,25 ± 5,48			13,88 ± 1,19		

Conclusions. The circuit training method can be effectively used to improve the strength endurance indicators of students studying in military training centers.

The circuit training method can provide the greatest increase in results when used in exercises with a more pronounced strength component or external resistance factor - for example, in exercises with weights (barbell squats), since short series with a change in muscle regions exposed to influence provide better recovery between approaches of bioenergetic systems responsible for the manifestation of strength abilities.

The circuit training method seems less effective when used in exercises with a longer duration of muscle tension (for example, in multi-repetition flexion and extension of the arms in a lying position), since the endurance component predominates in them.

References

1. Lysov L.P. Metodicheskoye planirovaniye programmy trenirovok. Scientific guidance edited by professor L.P. Lysov. Moscow: Sovetskiy sport publ., 2016. 264 p.
2. Sholikh M. Krugovaya trenirovka. Moscow: Fizkultura i sport publ., 1968.
3. Easter M. How Murph Became the Most Legendary Fitness Challenge Ever. 2021. Available at: https://www.menshealth.com/fitness/a36163839/murph-workout-crossfit-challenge/ (date of access: 24.04.2024).

Global trends in educational activities of sports universities

UDC 796.071

Dr. Hab., Professor **L.I. Lubysheva**[1]
Dr. Sc. Soc., Professor **S.I. Rosenko**[2]
[1]The Russian University of Sport «GTSOLIFK», Moscow
[2]Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg

Corresponding author: fizkult@teoriya.ru

Received by the editorial office on 12.07.2024

Abstract

Objective of the study was to pinpoint the key patterns and trends in the networking activities of Russian sports universities in the context of international expansion.

Methods and structure of the study. The examination of the key indicators of international educational and research activities in Russian institutions of higher learning specializing in physical education and sports is conducted.

Results and conclusions. Currently, the development of the international activities of Russian sports universities is characterized by new trends reflecting the specifics of the modern educational and scientific space. These include the implementation of online educational programs as a tool for building a unified educational trajectory of partner universities, the internationalization of scientific activities, the formation of an intra-university socio-cultural environment, etc. Collectively, these areas lead to an increase in the educational and scientific status of Russian sports universities and their international competitiveness.

Keywords: *network educational programs, international activities, sports, physical education, university*

Introduction. Currently, international activities of sports universities are one of the priority areas of their development, determining the formation of a new educational and scientific space. The main vectors of international integration in the field of higher sports education are the establishment of mutually beneficial interaction with foreign educational organizations, increasing the attractiveness of the educational programs being implemented, developing academic mobility of teachers and students, internationalizing the internal environment of sports universities, etc. The key results and criteria for the effectiveness of international activities are such indicators as the number of foreign students studying, the amount of income from the export of educational services, an increase in the volume of international scientific research and development in the field of physical education and sports. At the same time, modern realities dictate the need to search for new forms of development of international activities. In the educational segment, these primarily include the implementation of network programs using the resources of several universities, leading to the receipt of diplomas from participating universities. Russian sports universities and their foreign partners are beginning to build a joint educational trajectory, which undoubtedly increases their international status and determines qualitatively new employment opportunities for graduates. Considering the special role of sport and sports diplomacy in the development of international cooperation, the formation of network interaction in the field of physical culture is becoming especially relevant.

Objective of the study was to pinpoint the key patterns and trends in the networking activities of Russian sports universities in the context of international expansion.

Methods and structure of the study. The examination of the key indicators of international educa-

tional and research activities in Russian institutions of higher learning specializing in physical education and sports is conducted.

Results of the study and discussion. The accumulated experience of constructing educational programs in a network form has determined the algorithm of actions of their participants. The implementation of network programs is preceded by the conclusion of agreements between sports educational organizations (agreements on cooperation, on the network form of implementation of the educational program, a financial agreement), which form the basis for the development of a set of documents of the main professional educational program of higher education in the field of physical education and sports.

Next comes the stage of development and approval of the documentation included in the main professional program. The main condition for the construction of the curriculum and competence-oriented plans is their compliance with the educational and professional standards in force in the countries of the universities participating in the network program. It is this factor that determines the list of disciplines included in the curriculum, and the set of universal and professional competencies of graduates being formed.

In addition to the educational component, a necessary requirement for the implementation of network educational programs is also the coordination of its educational and methodological, personnel and material and technical support, as well as the construction of a «unified mechanism for ensuring learning outcomes and their assessment» [2, 14].

Taken together, the listed factors determine the necessary conditions that allow universities to implement network educational programs. Undoubtedly, the technologies for constructing sports network educational programs, on the one hand, have common characteristics, and on the other hand, they have specific features associated with the content of sports training and the requirements for the content of the types of professional activities of graduates in the areas of training of the UGSN «Physical Education and Sports» (coaching, pedagogical, organizational and methodological, scientific, etc.). There is already the first experience of implementing network programs in the field of physical education and sports. In 2023, the Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg began implementing a bachelor's degree program in a network form in the direction of training 49.00.01 – Physical Education (profile - Physical Culture and Health Activities) with the Shenyang Institute of Sport (PRC). Citizens of China - students of the Shenyang Institute, who are simultaneously enrolled in NSU named after P.F. Lesgaft. Thus, students enrolled in training acquire the status of students in both universities. It is planned that the implementation of the network program, which has received approval from the relevant Ministries of Russia and China, will last until 2031 and up to 60 students will be enrolled each year.

A necessary condition for the implementation of the network educational program is its compliance with the requirements of the Federal Educational Standard of Higher Education in the field of training 49.03.01 – Physical Education. In accordance with the standard, the parties developed and agreed on a curriculum for the educational program indicating the disciplines (modules), practices, workload, sequence and distribution by training periods, forms of educational activities, forms of ongoing monitoring of academic performance, as well as indicating the university implementing the relevant part of the educational program. Lesgaft University implements both sports and pedagogical disciplines in the training profile (theory and methods of teaching basic sports (athletics, gymnastics, skiing, short track, snowboarding) and theoretical disciplines (theory and methods of physical education, sports biochemistry, technologies of physical education and health activities, sports metrology, sports biochemistry, etc.). The educational process is organized in such a way that teachers of P.F. Lesgaft NSU conduct lectures and practical classes at the Shenyang Institute of Sports. Undoubtedly, the implementation of the network educational program required, in addition to the curriculum, the development of relevant documentation: program regulations, work programs of disciplines, bilingual statements, etc. This is a fairly complex and labor-intensive process aimed at creating educational and methodological support for the educational process. Particular attention is paid to the staff of teaching staff and their compliance with the necessary requirements: thus, the program involves teachers with academic titles and degrees, Olympic champions, masters of sports, etc. At the same time, a necessary condition for building a joint educational trajectory is both the coordination of efforts of the most diverse departments of the University (the educational and methodological center, international services, financial and economic management, etc.), and interaction on a permanent basis with simi-

lar departments of the Shenyang Sports Institute.

It is obvious that the implementation of the program unites the educational, pedagogical and resource potential of the universities participating in it, promotes the development of academic mobility, defines new opportunities and positions of universities in the international educational space.

At the same time, it should be noted that the process of implementing a network educational program is quite complex and requires solving a number of pressing issues. These include the lack of legal regulation for the construction and implementation of such programs [1]. First of all, this concerns the differences in national educational and professional standards on the basis of which network programs are built. Different content of credit units, differences in the wording of the competencies being formed, national requirements for conducting state final certification - all this leads to the need to find compromise solutions for building a joint educational trajectory, which are often not regulated in the legal field.

A separate issue is the language competence of students and teachers involved in the educational process. In the case of implementing network programs in foreign universities, ideally, teaching should be carried out either in the language of the country of study or in a pre-designated language (usually English). However, in practice, it is quite difficult to find teachers who speak English (and especially Chinese) at the level required to conduct classes. Also, the overwhelming majority of Chinese students have difficulty communicating in foreign languages. A temporary solution to this situation is simultaneous work with an interpreter. In this regard, it seems that the solution to this problem in the long term is to carry out advance work (implementing foreign language courses, organizing preparatory departments) to develop professional communication skills in all participants in the network educational program.

The identified problematic issues are a logical consequence of the initial stage of testing such a new and complex educational product as network educational programs. There is no doubt that they are the so-called «growing pains» and will be resolved as experience accumulates. The main result of the implementation of network interaction between universities is an increase in the quality of education, the use of foreign experience in building educational programs, an increase in the international status of participating universities, and, ultimately, the training of highly qualified specialists in the field of physical education and sports at a new level, in demand on the international labor market. It should be noted that the implementation of such programs leads to a significant increase in the share of foreign students in the structure of the student body of Russian sports universities, which is one of the criteria for the effectiveness of their activities. In addition to the emergence of new forms of educational interaction, the trend towards the internationalization of the scientific activities of sports universities is becoming increasingly evident. The indicators of its effectiveness are the regular holding of international congresses and conferences, the involvement of foreign scientists in joint publication activities and work on the editorial boards of scientific publications, the implementation of joint scientific projects, the development of the «visiting professor» program, etc.

Separately, it is necessary to note the tendency to increase the admission of foreign citizens to postgraduate studies: thus, in 2023, over 100 postgraduate students from foreign countries studied at Russian universities of physical education and sports. On the one hand, this indicates the high status of the Russian sports scientific school, and on the other hand, there are problematic issues related to the organization of the process of training foreign scientific personnel. We are talking about the effectiveness of training foreign postgraduate students, their attrition rates, the readiness of Russian teachers and scientists for scientific supervision, difficulties with the preparation and defense of dissertations, etc. In this regard, the experience of one of the leading sports universities in the country - the Russian University of Sports (GTSOLIFK), which is the leader in the number of foreign postgraduate students, which is 42% of their total number, is of interest. It should also be noted that the increase in the foreign contingent leads to the formation of a multinational youth community, which is characterized by large differences in national culture, lifestyle, and social communication. In this regard, an important condition for the implementation of international activities of sports universities is the formation of their socio-cultural environment, which allows preserving cultural traditions and expanding the opportunities for socialization and adaptation of students to new social conditions of life. The infrastructure of the socio-cultural environment unites all divisions of the university, as well as public associations and communities implementing social and educational activities within the educational organization. Designing a socio-cultural

environment is a technology for organizing the educational process, including the use of various methods, means and tools of national types of physical activity to improve the cultural level of students and establish effective social communication. The modern socio-cultural environment, aimed at social, everyday and cultural adaptation of foreign students, ensures free creative development of foreign students and the acquisition of positive experience in the process of studying at the university.

Conclusions. Thus, the development of international activities of sports universities is characterized by such trends as the introduction of new forms of educational cooperation (implementation of network educational programs in the field of physical education and sports), internationalization of scientific practice, formation of skills of professional foreign language communication among teachers and students, creation of a modern socio-cultural environment. In their totality, the development of these areas leads to an increase in the educational and scientific status of sports universities, defining a qualitatively new level of international cooperation in the field of physical education and sports.

References

1. Ilyina N.A., Serova O.A. Setevyye obrazovatelnyye programmy: evolyutsiya formirovaniya regulyatornogo podkhoda i voprosy prakticheskoy realizatsii setevoy formy sotrudnichestva. Aktualnyye voprosy rossiyskogo prava. 2024. Vol. 19. No. 5. pp. 72-83.
2. Kasprzhak A.G., Kobtseva A.A., Kuznetsova A.G. Setevyye obrazovatelnyye programmy kak mekhanizm povysheniya kachestva obrazovaniya v universitete. Study methodological guide. Natsionalnyy issledovatelskiy universitet «Vysshaya shkola ekonomiki», Institut obrazovaniya. Moscow: Vysshey shkoly ekonomiki publ., 2023. 122 p.

Predictors of sports education: current trends

UDC 796.01:378

Dr. Hab. **N.V. Masyagina**[1]
Dr. Hab. Professor **M.S. Leontyeva**[1]
Dr. Hab. Professor **I.V. Martynenko**[1]
Dr. Hab. Professor **V.I. Lyakh**[1]
[1]Moscow State University of Sport and Tourism, Moscow

Corresponding author: leontyeva72@mail.ru

Received by the editorial office on 21.06.2024

Abstract

Objective of the study was to elucidation of the fundamental principles of the theory of physical culture and sports, with an eye to contemporary circumstances.

Methods and structure of the study. The research was conducted at MSUSiT, where the content of scientific and educational publications was examined.

Results and conclusions. The fundamental principles of sports science are enriched by the findings of contemporary research. The definitions of sports and physical culture are clarified, and a distinctive framework for the structure of the field of physical culture and sports is presented. The position of sports theory within the scientific framework is established, and a diverse array of sports is identified. The multifaceted roles of physical culture are explored, and the interconnections between the constituent parts of the field of physical culture and sports are elucidated.

Keywords: *theory of physical education, theory of sports, sports education, modern trends*

Introduction. The dynamically changing socio-economic and political situation in our country in recent years contributes to the formation of many different views on the ideology of sports, approaches to defining the general cultural and special functions of physical culture and sports. These processes affect the modernization of the conceptual apparatus and the strengthening of the conceptual foundations of the industry, which is an integral part of its development and strengthening. At present, physical culture and sports are considered one of the most significant social phenomena, which has a profound impact not only on public life as a whole, but also on individual aspects of personal development in the professional environment.

Objective of the study was to elucidation of the fundamental principles of the theory of physical culture and sports, with an eye to contemporary circumstances.

Methods and structure of the study. The scientific research was conducted at the Moscow State University of Sport and Tourism, during which the information content of scientific and educational-methodical literature was studied. The results of the conducted innovative research were first announced in the framework of plenary reports at the International scientific and practical conference and round table «Ideology and key concepts of the modern theory of sports training», which took place at the Moscow State University of Sport and Tourism on April 16-17, 2024.

Results of the study and discussion. Forms of physical education. Forms of physical education developed several decades ago - basic, sports, professional-applied, background and health - are still used in the theoretical plane and practical activities. It should be clarified that the goals and purpose have undergone a number of changes, which must be further designated.

The purpose of the basic form of physical education is to ensure a basic level of general physical fitness, the formation of vital skills and abilities by the teacher, within the framework of pre-school educa-

tional organizations and general educational organizations.

Sports, in turn, is aimed at developing the maximum capabilities of the student, which is carried out through a system of training and competitions, when practicing children's and youth sports, high-performance sports, mass (amateur) sports. It is one of the powerful and effective means of physical improvement, satisfying aesthetic needs, expanding communication links.

The professional-applied form involves creating prerequisites for mastering a particular specialty (development of professional abilities). The leading varieties include military-applied and service-applied. The first is aimed at special physical training for military activities, increasing their effectiveness, and the second at special physical training of employees of law enforcement agencies to perform operational-service and service-combat tasks.

Background is a means of rest, restoration of strength with the help of physical exercises of a healthy but tired person, through the use of small forms - hygienic and restorative, which in turn contributes to the creation of a favorable background for human life (activities not associated with heavy loads).

The use of physical exercises with a therapeutic focus is classified as a health form, which is subdivided into health and rehabilitation, aimed at removing pathologies, restoring working capacity (physical therapy), and sports and rehabilitation, which focuses on restoring temporary working capacity or eliminating the effects of injuries).

Interpretation of basic concepts and definitions. According to the works of specialists [3-7], the concepts of ««Physical Culture», «Physical Education» and «Sport» are interpreted as similar, complementary and beneficially influencing the body and strengthening the health» [9, p. 290] of people of different age groups. In turn, the classical Soviet school of physical education theory suggests «significant differences between these definitions, which do not allow them to be considered synonyms» [9, p. 290].

In the modern world, the concepts of physical culture, physical education and sport are multifaceted. According to the Federal Law of the Russian Federation of 4.12.2007 No. 329-FZ «On Physical Culture and Sport in the Russian Federation» (Federal Law of 04.12.2007 No. 329-FZ (as amended on 24.06.2023) "On Physical Culture and Sports in the Russian Federation" Article 2. Basic concepts used in this Federal Law. Available at: https://docs.cntd.ru/document/902075039 (date of access: 20.04.2024). «Physical culture is a part of culture that represents a set of values, norms and knowledge created and used by society for the purposes of physical and intellectual development of human abilities, improvement of physical activity and formation of a healthy lifestyle, social adaptation through physical education, physical training and physical development» [11]. However, the term «physical culture» is considered by society from several positions, which is summarized in Figure 1 [9].

Sport, according to the above-mentioned law, is «a sphere of socio-cultural activity as a set of sports that has developed in the form of competitions and special practice of preparing a person for them» [11]. The main distinguishing «feature of sport is competitiveness, the desire to achieve maximum results through the development and improvement of highly specialized motor, psychophysiological and moral qualities in the process of training and competitive activities. Based on the interpretation of these terms, the concepts of physical culture and sport have a number of differences» [9, p. 291], today, from our point of view, these terms should be understood as follows. Physical culture is a set of material and spiritual values, norms,

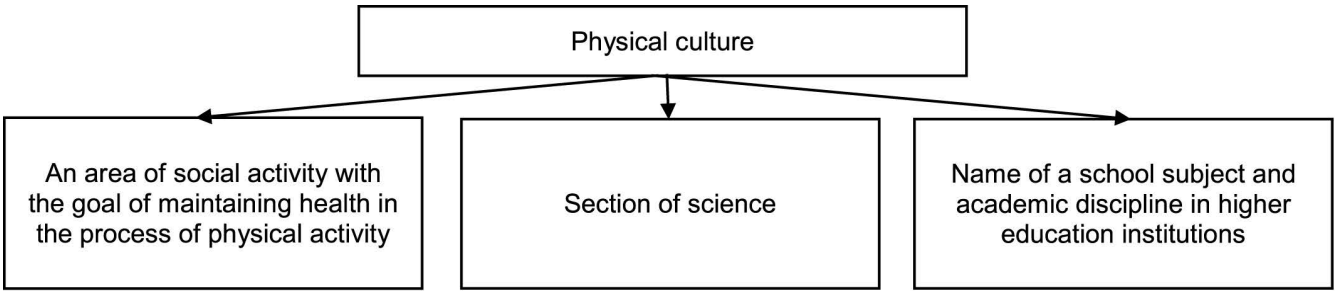


Figure 1. The versatility of the term «physical culture» in society

knowledge that contribute to the preservation and strengthening of health, physical improvement of the individual and the formation of a healthy lifestyle of a person and are part of the culture of society, where the main position should be played by the individuality of a person [1, 2]. Sport is the development of maximum physical and intellectual capabilities of a person in the process of sports training and participation in competitive activities under the direct guidance of a coach. The result of long-term sports activities is:

- increasing the body's reserve capacity;
- socialization of the individual;
- modeling of various aspects and forms of activity of a modern person.

The place of sport theory in the system of sciences. When discussing the topic of modern sport, it is worth determining the place of sport theory in the system of sciences, which is schematically presented in Figure 2 [8].

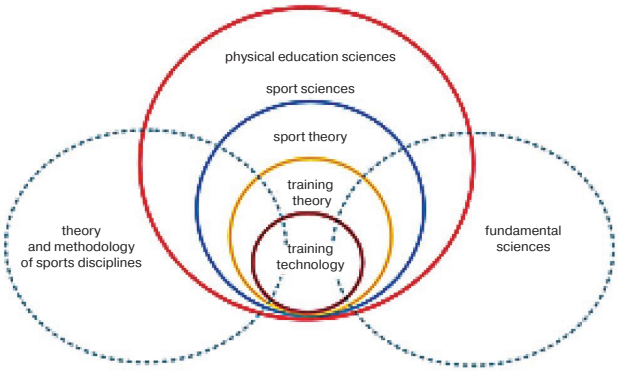


Figure 2. Theory of sport in the system of sciences (H. Sozanski, 2013)

Sports theory as an integrative scientific discipline must perform functions related to sports activities. This is expressed in the creation of a unified system of views serving the practice of training, in the definition of problems, the solution of which is currently necessary for the construction of a general theory of sports [10].

Types of sports. Today, sport is classified in two relatively independent, although socially and functionally interpenetrating in various configurations areas - these are high-performance sports and mass sports. It is worth noting that high-performance sports are understood as the result of people's natural needs to demonstrate their maximum capabilities, which is a powerful incentive for the development of mass sports, which, in turn, implies health promotion and disease prevention, self-affirmation and self-knowledge, rational organization of leisure. Sports in its broad manifestation contribute not only to improving the quality of life, but also to the formation of the readiness of those involved to perform social and labor and military-applied activities. Based on modern trends, as well as having analyzed the current legislation and the works of famous scientists in recent years, a team of authors proposed the following types of modern sports.

The modern multifaceted structure of sports activities, consisting of 10 complementary segments, closed in a circle, where each reflects different unique aspects of sports and its impact on society. From school to professional, from mass to high-performance sports, from student to corporate, from youth to amateur, from military-applied and service-applied to adaptive, and each variety emphasizes its role in the development of physical abilities, the formation of motor skills, strengthening health, social integration and achieving high sports results. The center of the circle contains the main idea, which is a powerful mechanism for the implementation of physical capabilities and the disclosure of the intellectual potential of a person through training and competition through competent guidance from a coach.

Functions of physical education. The next issue that we will outline concerns the diversity of physical culture functions. If the classical theory focused on four main functions, today it seems possible to outline a whole palette consisting of thirteen functions, each of which plays a unique role in the development of both man and society, namely historical, educational, health, upbringing, developmental, applied, social, patriotic, aesthetic (spectacular), preventive (warning), inclusive, economic, foreign policy. All the outlined functions, starting from the historical one, the meaning of which is to preserve and transmit cultural heritage, to the foreign policy one, reflecting the ability of the highest sporting achievements to increase the international authority of the state, clearly outline the significant contribution of physical culture to education, upbringing, social ties, the economy, as well as its importance in the formation of moral and aesthetic values of the individual.

Structure of the physical culture and sports industry. The final point that needs to be emphasized concerns the identified interrelations of the structural elements of the physical education and sports industry. Given the social nature of sports, it seems possible and timely to focus on the diversity

and harmony between the key components that answer the questions «Where?», «Who?», «How?» and «What?», directing us to various segments – from infrastructure and sports institutions to specialists, scientific research and educational programs of all levels and orientations.

It should be noted that the specialists of MSUSiT have developed a unique scheme of the structure (form) of the physical education and sports industry. Until now, such structural schemes have not been presented in the educational literature, which makes this methodological development a significant contribution to the academic study and further development of the discipline. The material presented by the authors of MSUSiT reflects how physical education and sports interact with every aspect of our lives, creating a healthy and active social environment. As part of the scientific search for modern directions of development of the theory of physical culture and sports, a team of scientists wrote a scientific monograph «Theory and Practice of Sports Training» under the general editorship of Professor V.P. Guba, Professor M.S. Leontyeva with the participation of a team of authors, which embodies a deep immersion in the key aspects of sports science, which include not only fundamental concepts, but also comprehensive scientific support for long-term training of personnel for the industry. This work enriches not only the academic discourse, but also provides valuable insights for further progress in the dynamically developing world of sports.

Conclusions. The development trends of physical culture and sport theory have significantly transformed in recent years and are now aimed at integrating innovations and interdisciplinary interactions that contribute to strengthening the conceptual apparatus and ideology. In this regard, it is necessary to revise scientific approaches to the theory and methodology of physical culture and sport in accordance with new realities and global trends in this area of science and practice.

References

1. Guba V.P., Chernova V.N. Sportivnaya morfologiya. Textbook for higher educational institutions. Institut turizma, rekreatsii, reabilitatsii i fitnesa Rossiyskogo gosudarstvennogo universiteta fizicheskoy kultury, sporta, molodezhi i turizma. Moscow: OOO «Torgovyy dom «Sovetskiy sport» publ., 2020. 352 p.
2. Guba V.P., Bulykina L.V., Achkasov E.E., Bezuglov E.N. Sensitivnyye periody razvitiya detey. Opredeleniye sportivnogo talanta. Moscow: «Sport» publ., 2021. 176 p.
3. Ermakova E.G. Znacheniye fizicheskoy kultury i sporta v zhizni studenta. Mezhdunarodnyy zhurnal gumanitarnykh i yestestvennykh nauk. 2018. No. 5-1. pp. 43-44.
4. Zamyatina M.R. Problemy i perspektivy razvitiya fizicheskoy kultury v Rossii. Innovatsionnyye pedagogicheskiye tekhnologii. Proceedings II International scientific conference, Kazan, May 20–23, 2015. Kazan: Buk publ., 2015. pp. 108- 110.
5. Mikhaylova T.A., Studenikina E.S. Problemy sporta i fizicheskoy kultury v rossiyskikh sotsiologicheskikh issledovaniyakh: istoriya i perspektivy razvitiya. Chelovek. Soobshchestvo. Upravleniye. 2017. Vol. 18. No. 4. pp. 121-136.
6. Naumenko Yu.V. Sotsialno-kulturnyy fenomen «Sport (sportivnaya deyatelnost)» kak obyekt pedagogicheskogo issledovaniya. Nauka i sport: sovremennyye tendentsii. 2018. Vol. 18. No. 1(18). pp. 117-125.
7. Rakhmatov A.I. Fizicheskaya kultura kak vid obshchey kultury individa. Molodoy uchenyy. 2018. No. 7(193). pp. 183-185.
8. Sozanski Kh. Teoriya i tekhnologiya sportivnoy podgotovki. Varshava-Belaya, Podlyaska: Akademiya fizicheskogo vospitaniya publ., 2013. pp. 3-21.
9. Sysoev A.V., Sedochenko S.V., Savinkova O.N. Kontseptualnyy analiz terminov «Fizicheskaya kultura» i «Sport». Uchenyye zapiski universiteta im. P.F. Lesgafta. 2019. No. 9(175). pp. 290-294.
10. Teoriya i praktika sportivnoy podgotovki. Monograph. V.V. Guba, M.S. Leontyeva [ed.]. Moscow: Sportivnaya kniga publ., 2024. 285 p.

Innovative teachers: structure and development in the field of physical education

UDC 796.015.58

PhD, Associate Professor **L.V. Morozova**[1]
T.I. Melnikova[1]
O.P. Vinogradova[1]
E.D. Butakova[1]
[1]The Russian Presidential Academy of National Economy and Public Administration, North-Western Institute of Management, St. Petersburg

Corresponding author: morozova-lv@ranepa.ru

Received by the editorial office on 05.05.2024

Abstract

Objective of the study was to formation of competencies for creative innovative activities of future physical education teachers.

Methods and structure of the study. The research was conducted using a competence-based approach to enhancing the creative abilities of physical education instructors. The methodology was grounded in the principles of system-based, factorial, and comparative analysis.

Results and conclusions. The essential elements of a creative individual are identified: innovative thinking, a focus on excellence, self-improvement, and adaptability. The constituent elements of the creative mindset of future physical education instructors are unveiled: a value-driven approach, a procedural framework, a reflective mindset, and a personal touch. It has been determined that the creative potential of a future professional is rooted in the cultivation of creative abilities and the pursuit of personal growth.

Keywords: *physical education, innovative teacher, competencies, creative innovative activity, humanization*

Introduction. The problem of training a physical education teacher with competencies in the formation of physical culture of an individual is relevant in the period of reforming the education system, focused on satisfying the hedonistic needs of a person and the introduction of innovative processes into the pedagogical practice of higher education [3]. The transition from a qualification to a competence approach is becoming the main direction of the development of pedagogy in modern higher education. There is a change in the vector of training a teacher to an erudite creative person with a flexible mind, creative abilities and reflexivity of what is happening [4, 7]. In the context of technologization of professional activity, the processes of developing creativity of employees are becoming more relevant [1, 6]. Of particular importance is the problem of training a physical education teacher capable of creative innovative activity based on the ability to integrate the components of pedagogical activity, possess the skills of rational use of means of pedagogical influence [2, 5].

Objective of the study was to formation of competencies for creative innovative activities of future physical education teachers.

Methods and structure of the study. The scientific work is based on a competence-structured approach to the development of creative abilities of a physical education teacher. The procedural basis was formed by system-structural, factor and comparative methods of analysis.

To determine the characteristic features of an innovative teacher, a survey was conducted, in which 48 specialists in physical education and sports took part, including seven professors, 24 associate professors, 10 senior teachers and seven teachers of higher education.

In accordance with the shift in emphasis of the educational paradigm in the direction of humanization

and self-development of the individual, the work paid attention to the prospective formation of orientation towards creative innovative activity of future physical education teachers.

Results of the study and discussion. The concept of «ability» was considered as an individual's property, determining his/her ability to perform a certain activity. Ability is determined by the level of knowledge, skills, abilities, personal qualities (character traits and temperament, features of the emotional-volitional sphere). Therefore, the focus on creative innovative activity can be defined as an integrative characteristic of the personality of a physical education teacher, ensuring professional success in typical and non-standard pedagogical conditions. In the course of the pedagogical study, the structural components of a creative personality were determined: creative thinking, acmeological orientation, creative self-development, motor variability (see table).

The study established that the creative potential of a future specialist lies in the development of creative abilities and the desire for self-development. The creative competence of a teacher is determined by psychological and pedagogical knowledge, general cultural erudition, professional and pedagogical thinking, special physical skills and abilities. To achieve a high level of creative activity, it is important to introduce theoretical and methodological and information and methodological support for the process of self-education of specialists based on the use of computer technologies into educational practice.

Formation of a focus on creative innovative activity of a future physical education specialist is a process of quantitative and qualitative transformations of personal characteristics, as well as the development of creative motives that determine the focus of creative innovative activity.

Characteristics of the personality of an innovative teacher

Characteristic personality traits	Rank indicator (%)
Creativity: -productivity; -originality; -flexibility	24,9 %
Constructive thinking skills	23,0 %
Synergy: - search; - discoveries	20,4 %
Cognition: - mental perception; - processing of external information	16,6 %
Tolerance: - interpersonal; - intercultural; - interethnic; - professional; - managerial; - gender	15,1 %

Based on the analysis of the experience of specialists in the field of physical education and sports, the following components of the focus of future physical education teachers on creative innovative activity were determined: value-motivational, content-processual, reflexive, personal (see figure).

The criteria and indicators of diagnostics, comprehensively reflecting the level of development of the selected ability, are determined on the basis of the methodology of creative development of personality and pedagogical creativity in accordance with the content of the structural components of the orientation of future physical education teachers to creative innovative activity.

The integrative nature of the orientation to creative innovative activity is confirmed by the mutual influence of the structural components and their components: interest in the profession, motivational and creative orientation of the personality, cognitive activity, desire for success (value-motivational component); level of knowledge, research competence, general pedagogical and ability for practical innovations (content-procedural component); adequacy of self-assessment (reflexive component); coefficient of creative capabilities (personality component).

In the process of human mental activity during the violation or deficiencies of certain elements in the structure of abilities, a general pattern of compensatory capabilities of human mental activity is revealed. Taking into account this pattern in the creative activity of a physical education teacher, it can be argued that the success of the activity will depend on many indicators. It should be taken into account that there is a relationship between the abilities and the position of the individual, which act as a need to engage in a certain type of activity. The abilities of the individual are revealed in the formation of a stable interest, as a determining factor in achieving high results in professional activity. The manifestation and development of creative abilities are influenced by ideological orientation, conviction, passion, conscious attitude to activity, diligence, and efficiency. The listed components are not only conditions for the development of abilities, but also act as additional stimulating factors for the creative innovative activity of future physical edu-

Value-motivational component	*Substantive and procedural component*	*Reflexive component*	*Personal component*
•value attitude to the teaching profession; •motivational and creative activity; •self-development, self-improvement, self-realization; •curiosity, interest, desire for creative achievements	•knowledge, skills, abilities; •proficiency in the methodology of pedagogical creativity; •ability of problem-based learning and scientific search for a problem, search for ways to solve pedagogical situations; •research skills; •various forms of pedagogical activity and professional interaction	•self-analysis and self-assessment of one's own activities; •control of the process of construction, implementation of innovations, critical analysis of professional activities	•the presence of professionally significant qualities (love for teachers, scientific and pedagogical worldview, responsibility, communication skills, creativity, empathy, organizational skills, research skills); •creativity as an integrative quality of the human psyche, ensuring the creative activity of the individual

Components of the ability of future physical education teachers to creative innovative activity

cation teachers. The ability for creative innovative activity is a combination of innate, stochastic, acquired creative abilities of the individual. Giftedness, talent and genius, as a manifestation of abilities, are impossible without constant work on oneself. Obviously, the development of abilities provides the necessary focus on creative and effective work of a physical education teacher. The issues considered equally relate to the formation of both the general competence of the teacher and the special training of the physical education teacher.

Conclusions. The revealed structure of the ability for creative innovative activity and the criterion levels of its assessment are components of the educational and methodological system for training a creative teacher. The integrative characteristic of the personality of a physical education teacher, ensuring the success of professional activity in typical and non-standard pedagogical conditions, is based on the use of various approaches in organizing and conducting the educational process: axiological, acmeological, ideological, competence-based, selective-variable, heuristic, creative. The integrative implementation of the listed approaches contributes to the formation of the ability for creative innovative activity of a higher school teacher in physical education.

References

1. Zyukin A.V., Ponimasov O.E., Gabov M.V., Ryzhkin N.V. Neytralizatsiya neblagopriyatnykh urbanisticheskikh faktorov sredstvami ekologo-didakticheskoy sredy vuza. Teoriya i praktika fizicheskoy kultury. 2021. No. 10. pp. 108-109.
2. Kiryanova L.A., Ponimasov O.E., Kolesnikov N.V., Vinogradova O.P. Polifunktsionalnaya fitnes-tekhnologiya fizicheskogo vospitaniya studentov upravlencheskikh spetsialnostey. Teoriya i praktika fizicheskoy kultury. 2023. No. 7. pp. 74-76.
3. Lubysheva L.I., Rosenko S.I. Novyye kontury razvitiya vysshego professionalnogo obrazovaniya v sfere fizicheskoy kultury i sporta. Teoriya i praktika fizicheskoy kultury. 2024. No. 1. pp. 3-5.
4. Mironov A.O., Ponimasov O.E., Morozova L.V., Melnikova T.I. Antikrizisnaya strategiya realizatsii fizicheskogo vospitaniya studentov v usloviyakh ogranicheniya zhiznedeyatelnosti. Teoriya i praktika fizicheskoy kultury. 2023. No. 3. pp. 61-62.
5. Morozova L.V., Melnikova T.I., Vinogradova O.P. Kompetentnostnyy podkhod po organizatsii obrazovatelnogo protsessa po fizicheskoy kulture v vuze. Sovremennyy vzglyad na nauku i obrazovaniye. Collection of scientific articles. Vol. IX. Moscow: Pero publ., 2021. pp. 42-45.
6. Morozova L.V., Kiryanova L.A., Morozov O.G. Sovremennyye obrazovatelnyye tekhnologii v protsesse podgotovki spetsialistov fizicheskoy kultury i sporta. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2016. No. 4 (134). pp. 182-186.
7. Frunze V.V., Kolesnikov N.V., Ponimasov O.E. Effektivnoye ispolzovaniye upravlencheskikh resursov v realizatsii proyekta «Sport – norma zhizni». Teoriya i praktika fizicheskoy kultury. 2024. No. 6. pp. 37-39.