EFFECTIVENESS OF THE TECHNOLOGY OF PREVENTION AND CORRECTION OF FUNCTIONAL DISORDERS OF THE MUSCULOSKELETAL SYSTEM IN CHEERLEADERS AT THE STAGE OF INITIAL TRAINING

ЕФЕКТИВНІСТЬ ТЕХНОЛОГІЇ ПРОФІЛАКТИКИ ТА КОРЕКЦІЇ ФУНКЦІОНАЛЬНИХ ПОРУШЕНЬ ОПОРНО-РУХОВОГО АПАРАТУ У ЧЕРЛІДЕРІВ НА ЕТАПІ ПОЧАТКОВОЇ ПІДГОТОВКИ

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Abstracts

Introduction. Specialists in the theory of sports consider athlete's health as a professionally significant value which is the basis of his reliability in the conditions of sports competitions and prospects at the stages of the long-term training process. A review of the available scientific data accumulated in the field of the use of corrective and preventive measures in the process of training young athletes has shown that at the moment this direction is in the stage of active formation and development, and the prospects of research are related to the health care of athletes of immediate and distant reserves of sports of higher achievements.

The objective of the study is to scientifically substantiate and develop a technology for prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training and to determine its effectiveness.

Research methods: theoretical analysis and generalization of literary sources; questionnaires, pedagogical observation, qualimetry. To determine the goniometry of young cheerleaders with different types of posture, the "APECS" program, a pedagogical experiment, and methods of mathematical statistics were applied.

Results. During this study, thanks to the experts, it was possible to single out the most important factors that are important for prevention and correction of disorders of the musculoskeletal system in young athletes.

The technology of prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training includes blocks of practical implementation: corrective and preventive, vertical stability, as well as the multimedia information and methodical system "Cheerleading star" and models of educational and training classes.

The results of a consistently transformative experiment confirmed the effectiveness of the developed author's technology for prevention and correction of functional disorders of the musculoskeletal system in young cheerleaders during educational and training sessions.

Conclusions. Implementation of the technology of prevention and correction of functional disorders of the musculoskeletal system in young cheerleaders has a positive effect on the condition of their posture and lower limbs. So, for example, the mean value of the index of symmetry of the shoulder girdle in the sagittal plane has changed statistically significantly in cheerleader girls with a round and round-concave back (α_2) на 1.80° ($Z = -2.677$; $p = 0.007$), angle of inclination of the pelvis in the sagittal plane (α_4) – на 6.79° ($Z = -2.549$; $p = 0.011$); the index of displacement of the body in the sagittal plane (α_5) improved by 1.71° ($Z = -2.549$; $p = 0.011$). It should be noted statistically significant changes in such indicators as the level of the shoulder blades in the frontal plane (β_3) ($Z = -2.549$; $p = 0.011$) and foot valgus ($Z= -2.371$; $p = 0.018$). At the same time, it was established that the indicators of symmetry of the shoulder girdle in the

frontal plane (β_2) and the level of the knees in the frontal plane (β_6) did not undergo statistically significant ($p>0.05$) changes.

Key words: complex coordination sports, cheerleading, young athletes, health, musculoskeletal system, functional disorders, technology, prevention, correction.

Вступ. Фахівці теорії спорту розглядають здоров'я спортсмена як величину професійно значущу, яка є основою його надійності в умовах спортивних змагань та перспективності на етапах процесу багаторічної підготовки. Розгляд наявних наукових даних, накопичених у сфері використання корекційно-профілактичних заходів у процесі підготовки юних спортсменів, засвідчив, що в поточний момент цей напрям перебуває у стадії активного формування та розвитку, а перспективи досліджень пов'язані з охороною здоров'я спортсменів найближчого та віддаленого резервів спорту вищих досягнень.

Мета дослідження – науково обґрунтувати та розробити технологію профілактики та корекції функціональних порушень опорно-рухового апарату у черлідерів на етапі початкової підготовки та визначити її ефективність.

Методи дослідження: теоретичний аналіз і узагальнення літературних джерел; анкетування, педагогічне спостерження, кваліметрія. Для визначення гоніометрії у юних черлідерів із різними типами постави використовувалась програма «APECS», педагогічний експеримент, методи математичної статистики.

Результати. Під час проведення цього дослідження завдяки експертам удалося виокремити найбільш суттєві фактори, які є важливими для профілактики та корекції порушень опорно-рухового апарату у юних спортсменів.

Технологія профілактики та корекції функціональних порушень опорно-рухового апарату у черлідерів на етапі початкової підготовки включає блоки практичної реалізації: корекційно-профілактичний, вертикальну стійкість, а також мультимедіа інформаційно-методичну систему «Cheerleading star» та моделі навчально-тренувальних занять.

Результати послідовно перетворювального експерименту підтвердили ефективність розробленої авторської технології профілактики та корекції функціональних порушень опорно-рухового апарату у юних черлідерів у процесі навчально-тренувальних занять.

Висновки. Впровадження технології профілактики та корекції функціональних порушень опорно-рухового апарату у юних черлідерів позитивно впливає на стан їхньої постави та нижніх кінцівок. Так, наприклад, у дівчат-черлідерів з круглою та круглоувігнутою спиною статистично значущо змінилося середнє значення показника симетричності плечового поясу у сагітальній площині (α_2) на 1,80° ($Z = -2,677$; $p = 0,007$), кут нахилу таза у сагітальній площині (α_4) – на 6,79° ($Z = -2,549$; $p = 0,011$); показник зміщення тіла у сагітальній площині (α_5) покращився на 1,71° ($Z = -2,549$; $p = 0,011$). Слід відзначити статистично значущі зміни таких показників, як рівень лопаток у фронтальній площині (β_3) ($Z = -2,549$; $p = 0,011$) і вальгус стопи ($Z= -2,371$; $p = 0,018$). Разом із тим встановлено, що показники симетричності плечового поясу у фронтальній площині (β_2) і рівень колін у фронтальній площині (β_6) не зазнали статистично значущих ($p>0,05$) змін.

Ключові слова: складнокоординаційні види спорту, черліденг, юні спортсмени, здоров'я, опорно-руховий апарат, функціональні порушення, технологія, профілактика, корекція.

Introduction. Modern studies indicate the prevalence of functional disorders of the musculoskeletal system in young athletes [17; 23; 24]. A number of scientists see the origins of the causes of this problem in insufficient emphasis on the health-preserving orientation of sports training of young athletes [13; 20]. Incorrect posture [5; 6] and muscle imbalance [7; 8] negatively affect the effectiveness of the training process [18; 19]. Functional disorders reduce functional capabilities of the cardiovascular [1], respiratory [10; 12; 14], digestive and nervous systems [13; 22], as well as adaptive abilities of the body [2; 3].

The problem of violations of the biomechanics of the musculoskeletal system of young athletes is one of the central problems in the context of a health-preserving approach in the system of sports training [13; 21]. The results of the research obtained by M. Grabara, A. Hadzik [15] show that the posture of young athletes is most often characterized by asymmetry of the shoulders and shoulder blades, disturbances in the sagittal plane. The authors suggest that this is related to the running technique, a large load on the spine during running, determined by the asymmetry of the shoulders and shoulder blades in young track and field athletes. S. Bagherian,

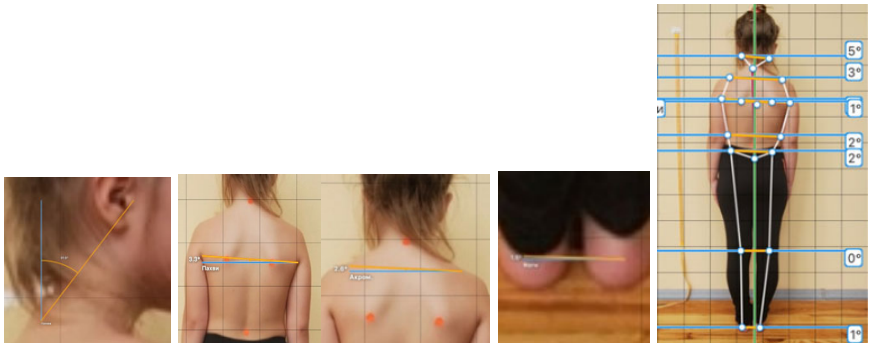
N. Rahnama, R. Rajabi [11] studied the issue of whether the posture while riding a bicycle affects the appearance of kyphosis in skilled cyclists. The results of this study showed that skilled cyclists have the highest degree of kyphosis [11]. S. Augustsson, H. Shahrokhi, D. Haneshmandi, P. Rahmani, A. Javaheri [9] found a statistically significant ($p<0.05$) difference in the prevalence of kyphosis and lordosis in athletes and in people who do not do sports and noted that the best predictors of kyphosis and lordosis are arm span and spine length.

Cheerleading is a sport with a complex coordination structure of movements. In the works of a number of authors, various approaches to the prevention and correction of posture disorders are described [5]. However, these technologies and programs were developed without taking into account the peculiarities of the educational and training process in cheerleading. In the context of the above, the importance of the problem of prevention, early diagnosis and correction of postural disorders of young cheerleaders is highlighted.

The objective of the study is to scientifically substantiate and develop a technology for prevention and correction of functional disorders of support in cheerleaders at the stage of initial training.

Research materials and methods. Experimental studies were conducted at the Department of Kinesiology and Physical Culture and Sports Rehabilitation of the National University of Physical Education and Sports, CheerNika School of Cheerleading (Kyiv) in the period from January 2019 to December 2023. *Participants of the research.* During the experiment, 37 experts (trainers of the All-Ukrainian Cheerleading Federation) and 27 cheerleaders aged 6–8 years were involved. The research was conducted in compliance with the requirements of the Declaration of Helsinki of the World Medical Association "Ethical principles of medical research involving a person as an object of research". *Research methods.* Theoretical – for studying and substantiating the basic provisions of the research, outlining its problem area. Sociological: 37 experts participated in the survey. The questions included in the questionnaire and the respondents' answers to them made it possible to establish: the relevance of the problem of prevention of functional disorders of the musculoskeletal system in young cheerleaders, the adequacy of measures for the prevention of functional disorders of the musculoskeletal system in athletes at the stage of initial training, the need to improve the process of preventing functional disorders of the musculoskeletal system in young cheerleaders, the use by coaches of modern scientific information on technologies for the prevention of functional disorders of the musculoskeletal system in young athletes, the use by coaches of modern methods of diagnosing functional disorders of the musculoskeletal system in young cheerleaders, integration into home tasks of young athletes of physical exercises aimed at prevention of functional disorders of the musculoskeletal system. Qualimetry is a method of expert assessments [3; 4]. When conducting an examination using the method of giving preference, the calculated value of the concordance coefficient is $W=0.85$ at ($p<0.05$), and $W=0.79$ ($p<0.05$), that is, the results of the examination can be trusted, the examination itself can be considered as that happened, and the opinion of the experts was agreed upon. The value of the concordance coefficient varies in the range from 0 to 1, where 0 is the absolute lack of agreement of the experts' opinion, 1 is complete agreement. The statistical significance of the concordance coefficient was determined by the χ^2 – Pearson's test. It was taken into account that the expert evaluation should be carried out by highly qualified and experienced specialists, therefore it was carried out with the participation of 19 experts (coaches of the All-Ukrainian Cheerleading Federation; the trainers' experience is 5 years). Pedagogical observation as a method of empirical level of research – for familiarization with the process of organization of educational and training classes of primary training groups. The "APECS AI" program was used to determine posture types (Pic. 1), the examination was conducted with the participation of an orthopedist. A sample of the diagnosis of the posture of young cheerleaders is presented in Pic. 1.

Angles with the largest deviations Frontal profile of the posture of the athlete



Pic. 1. Diagnosis of the posture of young cheerleaders with the help of the "APECS AI" program

The successive transformative experiment provided for the determination of the nature of the influence of the experimental technology, in particular the algorithm of its practical implementation, under the condition of the use of appropriately selected and combined methods and means, on the prevention and correction of functional disorders of the musculoskeletal system in young cheerleaders.

Methods of mathematical statistics. Descriptive analysis was used to process the obtained experimental data, their systematization, visual presentation in the form of graphs and tables, as well as their quantitative description using basic statistical indicators. The following statistical indicators were calculated: arithmetic mean, standard deviation (S), standard error (m), 95 percent confidence interval for the grand mean. In case of non-compliance of the data with the normal distribution law, the median (Me), lower (25%) and upper (75%) quartiles were determined.

To assess the statistical significance of the differences between the values of indicators that were not subject to the normal distribution law, the z-statistics of the non-parametric Wilcoxon T-test (n>25) was used for dependent samples.

ANOVA variance analysis was used to compare indicators of physical development of 6–8-year-old cheerleader girls, depending on age, and the non-parametric Kruskel-Wallis H-test was used to compare indicators of the state of the biogeometric profile of posture.

To establish differences in anthropometric indicators and indicators of the biogeometric profile of the posture of cheerleader girls aged 6–8 with different types of posture, the median test of Friedman's χ^2 for k-samples was used.

To determine where the differences came from, after obtaining statistically significant results regarding differences both in age and in relation to the form of postural disorders based on the Kruskel-Wallis H-test, Dunnett's non-parametric post hoc test was used which made it possible to distinguish homogeneous subgroups: 6 years and 7–8 years for anthropometric indicators, except chest circumference where the entire age range is homogeneous; three homogenous groups were distinguished regarding the form of postural disorders: 1 – normal posture, 2 – concave and round back, 3 – scoliotic posture; according to all indicators of the biogeometric profile of the posture, the age of 6–8 years appears as homogeneous.

To perform a comparative analysis of the indicators of the biogeometric profile of the posture of 6–8-year-old cheerleader girls with different types of posture disorders before and after the experiment, the non-parametric Wilcoxon T-test for paired samples was used, which is the most informative when the sample number is up to 25 items.

Within the scope of the study, p values were rounded to the nearest thousandth. The lowest level of statistical reliability was accepted at P = 90% – the level of statistical significance p = 0.10, other results were obtained at higher levels of significance.

The results of experimental studies were processed using the SPSS Statistics 17.0 software package from IBM.

Results. During this study, thanks to the experts, it was possible to single out the most important factors that are important for the prevention of disorders of the musculoskeletal system in young cheerleaders [4; 5]. The conducted expert assessment made it possible to single out the most important factors that negatively affect the musculoskeletal system during educational and training sessions. As a result of the expert evaluation, it was established that the concordance coefficient was $W=0.85$ ($p<0.05$), and the main factor of the low efficiency of the training process of young athletes is "the absence of a system for the prevention of functional disorders of the musculoskeletal system of young cheerleaders" (first place) [4; 5].

The technology was developed taking into account the approximate plan-schedule of the annual cycle of training for groups of initial training of cheerleaders.

The substantiation of the structure and content of the author's technology was preceded by analytical work on the definition of methodological and theoretical-empirical categorical determinants that determine their essential characteristics.

The stages of designing the author's technology:

1st stage (diagnostic) – diagnostics that precedes actual design activities. This kind of diagnosis serves to assess the condition of the musculoskeletal system of young cheerleaders. The higher the objectivity of the data obtained during diagnostics, the more accurate the guidelines for designing corrective and preventive measures;

2nd stage (pre-development) – choosing a strategy for corrective and preventive measures – determining guidelines for building a project of a system of educational and training classes (leveling the consequences of previous diseases; correcting existing functional disorders of the musculoskeletal system; forming a sustainable need for systematic physical exercises, maintaining a healthy lifestyle life;

3rd stage (development) – development of models of a typical lesson and the lesson program as a whole, including the selection of tools, methods, methodological techniques, load and rest parameters which ensure the achievement of the planned results;

4th stage (implementation) – implementation of the program of classes during which the actual indicators of the musculoskeletal system of the athletes gradually converge with their planned values;

5th stage (control-corrective) – evaluation of the effectiveness of the classes is carried out which is determined by the achieved indicators of the musculoskeletal system of young cheerleaders.

General and special tasks of the technology of prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training: gradual development of strength and endurance of the trunk muscles, formation of a muscular corset; harmonious development of the bone-binding apparatus of the lower limbs of young cheerleaders; forming the correct posture and consolidating the skills of the correct statodynamic posture of young cheerleaders; strengthening of the arch of the foot of female athletes; correction of unfixed disorders of the musculoskeletal system in the sagittal and frontal planes of young cheerleaders; increasing the body's resistance to pathological factors.

Educational and training classes for cheerleaders at the stage of initial training with functional disorders of the musculoskeletal system will acquire a health-improving orientation under the following organizational and pedagogical conditions:

– taking into account during deveopment and specific planning of corrective and preventive measures the individual characteristics of the biomechanics of the musculoskeletal system of young athletes and the sequence of their performance of physical improvement tasks;

– use for evaluation of physical development data of cheerleaders at the stage of initial training, in addition to generally accepted characteristics, indicators of biomechanics of posture, foot and anthropometric indices;

– provision in technology, in addition to general developmental exercises, of physical

exercises for correcting functional disorders of the musculoskeletal system which are performed with strict regulation of the body's gravitational interactions, taking into account the individual characteristics of the motility of young athletes, the specifics of their adaptation adjustments, the achieved level of individual physical development of each athlete with an orientation to a given level corresponding to age norms of physical development;

– monitoring of the state of the musculoskeletal system of young athletes during training based on modular monitoring of the spatial organization of their bodies.

The technology of prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training includes blocks of practical implementation: corrective and preventive, statodynamic posture, vertical stability, models of educational and training classes, multimedia information [25] and methodical system "Cheerleading Star".

Implementation of the practical part of the author's technology for the prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training was carried out in the form of a sequential transformative experiment. For this purpose, based on the results of the ascertainment experiment, 13 female cheerleaders aged 6–8 years with postural disorders were selected (whose parents gave their permission for the children to participate in the pedagogical experiment): 9 – with rounded concave and round backs, 4 – with scoliotic posture who engaged in the proprietary technology developed by us. The selection of the most informative criterion for testing the hypothesis about the effectiveness of the developed and implemented technology for the prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training was carried out on the basis of checking the correspondence of the indicators of biogeometric indicators of posture to the normal distribution according to the Shapiro-Wilk W-criterion. The null hypothesis for these criteria is that the data distribution differs from the normal one at the criterion level of $p>0.05$. According to the research data, the *p* indicators for the Shapiro-Wilk test for almost all indicators of the biogeometric profile of the posture of cheerleader girls indicate the absence of a normal distribution of the obtained indicators.

The average values of the indicators of the biogeometric profile of the posture of 6–8-year-old cheerleader girls before and after the sequential transformation experiment are shown in the Table. 1.

As the results of the comparative analysis according to the non-parametric Wilcoxon T-test showed, the average value of the angle of inclination of the head in the sagittal plane (α_1) decreased by 8.33° in girls-cheerleaders with a round and round-concave back statistically significantly ($p<0.05$) ($Z = -2.668$; $p = 0.008$), while in girls with scoliotic posture this indicator changed at the level of a statistical trend ($Z = -1.841$; $p = 0.066$). The angle of the pelvis in the sagittal plane (α_4) also changed statistically significantly in cheerleader girls with a round and concave back – by 6.79° ($Z = -2.549$; $p = 0.011$); in cheerleader girls with scoliotic posture, this indicator improved only by 0.95° ($Z = -1.000$; $p = 0.317$).

The average value of the index of symmetry of the shoulder girdle in the sagittal plane (α_2) changed statistically significantly by 1.80° ($Z = -2.677$; $p = 0.007$) in cheerleader girls with a round and round-concave back; in girls with a scoliotic posture, this indicator did not undergo statistically significant changes ($Z = -0.368$; $p = 0.713$).

The index of body displacement in the sagittal plane (α_5) underwent similar changes: in 6–8-year-old cheerleader girls with a round and round-concave back, it improved by 1.71 ($Z = -2.549$; $p = 0.011$), with scoliotic posture – by 1.85 ($Z = -1.841$; $p = 0.066$).

The pelvic tilt angle in the sagittal plane (α_4) also changed statistically significantly in cheerleader girls with a round and concave back – by 6.79° ($Z = -2.549$; $p = 0.011$); in cheerleader girls with scoliotic posture, this

Table 1

Characterization of the biogeometric profile of the posture of cheerleader girls 6–8 years old before and after the experiment (n = 13)

Posture indicators		Average statistics					
		$\bar{x}$	95% confidence interval		Me	s	m
			lower limit	upper limit			
1		2	3	4	5	6	7
Round concave, round back (n=9)							
Angle of inclination of the head in the sagittal plane (α_1), degrees	Before	35.7222	32.6892	38.7552	36.0000	3.94581	1.31527
	After	27.3889	26.5334	28.2444	27.5000	1.11293	0.37098
	Z=-2.668[a]; p=,008						
Symmetry of the shoulder girdle in the sagittal plane (α_2), degrees	Before	6.4333	5.2247	7.6420	6.7000	1.57242	0.5241
	After	4.6333	4.2194	5.0473	4,.9000	0.53852	.01795
	Z=-2.677[a]; p=,007						
The angle of inclination of the pelvis in the sagittal plane (α_4), degrees	Before	13.5556	10.7665	16.3446	15.0000	3.62840	1.2094
	After	6.7667	5.8159	7.7175	7.0000	1.23693	0.4123
	Z=-2.549[a]; p=,011						
Displacement of the body in the sagittal plane (α_5), degrees	Before	2.8333	1.6308	4.0359	2.7815	3.0000	0.5214
	After	1.1222	.7441	1.5003	1.0000	0.49188	0.1
	Z=-2,549[a]; p=,011						
Symmetry of the shoulder girdle in the frontal plane (β_2), degrees	Before	1.2411	.4089	2.0733	.7000	1.08269	.36090
	After	.7667	.3234	1.2099	.7000	0.57663	0.1922
	Z=-.943[a]; p=.345						
Angle of inclination of the pelvis in the frontal plane (β_4), degrees	Before	1.7333	.9861	2.4806	2.0000	0.97211	0.3240
	After	.8856	.6680	1.1031	.8000	0.28307	0.0943
	Z=-2.254[a]; p=.024						
The level of the knees in the frontal plane (β_6), degrees	Before	1.7556	.5616	2.9495	1.3000	1.55331	.51777
	After	1.0644	.5483	1.5806	.8000	0.67147	.22382
	Z=-1.363[a]; p=.173						
The level of the shoulder blades in the frontal plane (β_3), degrees	Before	2.1333	1.1437	3.1229	1.5000	1.28744	0.4291
	After	1.0000	.7930	1.2070	1.0000	0.26926	0.0897
	Z=--2.549[a]; p=.011						
Shin, degrees	Before	8.5778	7.1884	9.9671	8.9000	1.80747	0.6024
	After	5.6556	5.0700	6.2411	5.5000	0.76176	0.2539
	Z=-2.490[a]; p=.013						
Fibula, degree	Before	4.4444	2.4122	6.4767	3.2000	2.64391	0.8813
	After	3.8222	2.9443	4.7001	3.8000	1.14212	0.3807
	Z=-.840[a]; p=.401						
Valgus of the foot, degrees	Before	3.2000	1.8217	4.5783	2.5000	1.79304	0.5976
	After	1.4889	1.1804	1.7974	1.5000	0.40139	0.1338
	Z=-2.371[a]; p=.018						
Scoliotic posture (n=4)							
Angle of inclination of the head in the sagittal plane (α_1), degrees	Before	31.0250	23.4823	38.5677	29.0000	4.74017	2.3700
	After	26.7500	25.2265	28.2735	26.5000	0.95743	0.4787
	Z=-1.841[a]; p=.066						
Symmetry of the shoulder girdle in the sagittal plane (α_2), degrees	Before	6.2500	2.7217	9.7783	7.0000	2.21736	1.10868
	After	5.2500	3.2478	7.2522	5.0000	1.25831	0.62915
	Z=-.368[a]; p=.713						
The angle of inclination of the pelvis in the sagittal plane (α_4), degrees	Before	6.7500	3.2217	10.2783	6.0000	2.21736	1.1086
	After	5.8000	4.9382	6.6618	6.0000	.54160	0.2708
	Z=-1.000[a]; p=.317						

Continuation of table 1

1		2	3	4	5	6	7
Displacement of the body in the sagittal plane (α_5), degrees	Before	3.4750	.7641	6.1859	3.4500	1.70367	0.8518
	After	1.6250	.4316	2.8184	1.5000	0.75000	0.3750
	Z=-1.841[a]; p=.066						
Symmetry of the shoulder girdle in the frontal plane (β_2), degree	Before	3.6000	2.8205	4.3795	3.7000	0.48990	0.2449
	After	1.6250	.12500	1.2272	2.0228	1.5000	0.2500
	Z=-1.826[a]; p=.068						
Angle of inclination of the pelvis in the frontal plane (β_4), degrees	Before	1.8750	1.4772	2.2728	2.0000	0.25000	0.1250
	After	.9250	.7727	1.0773	.9500	0.09574	0.0478
	Z=-1.841[a]; p=.066						
The level of the knees in the frontal plane (β_6), degrees	Before	3.0500	2.6496	3.4504	3.0000	0.25166	0.1258
	After	1.3250	.4693	2.1807	1.2500	0.53774	0.2688
	Z=-1.841[a]; p=.066						
The level of the shoulder blades in the frontal plane (β_3), degrees	Before	4.0500	2.7411	5.3589	4.1000	0.82260	0.4113
	After	1.7000	.7453	2.6547	2.0000	0.60000	0.3000
	Z=-1.841[a]; p=.066						
Shin, degrees	Before	5.0500	.1429	9.9571	4.3500	3.08383	1.5419
	After	4.6250	2.0778	7.1722	4,7500	1,60078	0,8003
	Z=.000[b]; p=1.000						
Fibula, degrees	Before	4.1250	-1.0121	9.2621	3.5000	3.22839	1.6141
	After	3.2500	1.2478	5.2522	3.0000	1.25831	0.6291
	Z=-.730[a]; p=.465						
Valgus of the foot, degrees	Before	3.7750	1.0147	6.5353	3.5000	1.73469	0.8673
	After	2.2250	1.3995	3.0505	2.0000	0.51881	0.2594
	Z=-1.826[a]; p=.068						

Note. $\bar{x}$ – sample arithmetic mean; Me – the median; s – standard deviation; m – standard error* – statistically significant differences between the values of the indicators before and after the experiment according to the Wilcoxon T-test ($p < 0.05$).

indicator improved only by 0.95° (Z = -1.000; p = 0.317).

Similar changes in the indicators of the biogeometric profile of posture in 6-8-year-old cheerleader girls also occurred in the frontal plane. Thus, the average values of the angle of inclination of the pelvis in the frontal plane (β_4) in girls with round and rounded backs improved by 0.85° (Z = -2.254; p = 0.024), with scoliotic posture – by 0.95° (Z = – 1.841; p = 0.066).

The index of symmetry of the shoulder girdle in the frontal plane (β_2) and the level of the knees in the frontal plane (β6) at the level of statistical significance ($p<0.05$) improved only in girls with scoliotic posture by 1.98° (Z = -1.826; p = 0.068) and 1.73° (Z = -1.841; p = 0.066), while these indicators did not undergo statistically significant ($p>0.05$) changes in girls with round and concave backs.

It should be noted statistically significant ($p<0.05$) changes in such indicators as the level of the shoulder blades in the frontal plane (β_3) (Z = -2.549; p = 0.011) and foot valgus (Z= -2.371; p = 0.018) in girls-cheerleaders with a round and round-concave back, in the same contingent of subjects with scoliotic posture, these indicators also changed – by 2.35° (Z = -1.841; p = 0.066) and 1.55° (Z = -1.826; p = 0.068) respectively.

The shin index also underwent statistically significant ($p<0.05$) changes in cheerleader girls, which improved by 2.92° (Z = -2.490; p = 0.013), while in girls with scoliotic posture it practically did not change (Z = -0.000; p = 0.995).

It should be noted that the index of the fibula in the studied contingent did not undergo statistically significant ($p>0.05$) changes during the experiment.

Thus, in cheerleader girls with a round and concave back, almost all indicators differ statistically significantly ($p<0.05$) before and after the pedagogical experiment, except for the indicators of symmetry of the shoulder girdle in the frontal plane (β_2) (Z= – 0.943; p = 0.345), knee level in the frontal plane (β_6)

(Z = -1.363; p = 0.173) and fibula (Z = – 0.840; p = 0.401).

In cheerleader girls with scoliotic posture, most indicators of the biogeometric profile of the posture underwent changes at the given level of statistical significance (Z=0.050≤p≤0.100), except for the symmetry of the shoulder girdle in the sagittal plane (α_2) (Z = -0.368; p = 0.713), pelvic tilt angle in the sagittal plane (α_4) (Z = -1.000; p = 0.317), shin (Z = 0.000; p = 0.995) and fibula (Z = -0.730; p = 0.465).

Discussion. Correct posture determines the normal functioning of all organs and systems of the body, which becomes especially important under conditions of increased physical exertion during sports [10; 15]. The results of our research supplemented the conclusions of specialists [18] about the increase in the number of young athletes with functional disorders of the musculoskeletal system. According to L. Radu, R. Petrea [20], the diagnosis of postural asymmetry of athletes is of great importance at the stage of initial training. The data obtained in the study [20] point to the fact that shoulder and scapular asymmetry is more common in young female athletes compared to boys. The conducted research made it possible to supplement the results of research in this direction.

In recent decades, we have witnessed a tendency to introduce into the system of biomechanical control of the morphofunctional state of young athletes indicators that allow diagnosing disorders of the musculoskeletal system. Agreeing with the above information, one should also agree with the fact that the body goniometry indicators of young athletes are important indicators of the state of posture. The conducted research made it possible to supplement the information component of the scientific studies of specialists in this direction [9; 13].

Expert assessment was and remains an important and effective method of research as it allows to use the significant theoretical and practical potential of specialists in one or another field of social activity [1; 23; 24]. During the conduct of this research, thanks to the experts, it was possible to single out the factors that are important for the prevention of disorders of the musculoskeletal system in young cheerleaders [4; 5].

The data [2; 6; 7; 11] regarding the content and direction of biomechanical monitoring of the state of biomechanics of young athletes received further development.

Conclusions. A substantiated technology for the prevention of functional disorders of the musculoskeletal system in young cheerleaders, the characteristic features of which are: socio-pedagogical prerequisites, five stages of design (diagnostic, pre-design, design, implementation, control-corrective), goal, general and special tasks, principles general pedagogical orientation and corrective-preventive activities, organizational and pedagogical conditions, indicative models of educational and training classes, blocks of practical implementation, informational and methodical system "Cheerleading Star". The implementation of the author's technology takes into account a number of requirements: conceptuality, anthropocentrism, situationality, contextuality.

The results of the pedagogical experiment indicate that the use of the developed technology for the prevention and correction of functional disorders of the musculoskeletal system in cheerleaders at the stage of initial training made it possible to improve the state of their spatial organization of the body.

The development of the specified technology for the prevention of functional disorders of the musculoskeletal system of young athletes has significant theoretical, practical and social significance for preserving, maintaining and strengthening the health of athletes in the process of the first three stages of multi-year training and prolonging their sports longevity.

Conflict of interests. The authors declare that there is no conflict of interests.

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