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Programming of the Training Process for Qualified Female Volleyball Players in the Preparatory Period of the Annual Training

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Objectives. The study aimed to experimentally prove the efficiency of building structural formations of the training process for qualified female volleyball players within the preparatory period of the annual training cycle on the basis of programming.

Material and methods. Qualified female volleyball players from the first category of the student team (n = 16) participated in the experiment, with an average age of 19.56 ± 0.81 years. The research was carried out during 2023-2024 and included two stages of a sequential pedagogical experiment — ascertaining and formative. The formative experiment provided the development and experimental substantiation of efficiency for introducing interconnected programs of structural formations in the training process of qualified volleyball players within the preparatory period of the annual macrocycle (programs of the period, meso- and microcycles, training sessions and their parts — training tasks). The criteria of efficiency were the indicators of physical fitness (a standing high jump, a throw of a stuffed ball of mass 1 kg with two hands from behind a head on a distance, a shuttle run of 30 m according to the scheme 9-3-6-3-9 m, and a run "herringbone" of 92 m), functional fitness (fat content and muscular components in the body, relative maximum consumption of oxygen), technical and tactical fitness (the coefficient of efficiency of technical and tactical actions).

Results. At the formative stage of the experiment, in comparison with the ascertaining one, the volume of training loads was reduced by 5.7 % (from 5725 to 5400 min), the load value was reduced by 4.9 % (from 41804 to 39742 points), the intensity of loads was increased by 1.4 % (from 7.3 to 7.4 points/min); the share of general preparatory (from 44.0 to 40.3 %) and introductory (from 37.3 to 34.3 %) exercises was decreased, however, due to this the share of specially-preparatory (from 6.8 to 8.3 %) and competitive (from 11.9 to 16.1 %) exercises was increased; the share of loads of mixed aerobic-anaerobic (from 40.9 to 41.3 %), anaerobic alactate (from 5.0 to 9.2 %) and anaerobic glycolytic orientation (from 3.7 to 4.3 %) was increased due to the decrease of the share of aerobic orientation loads (from 50.4 to 45.3 %).

Conclusions. The findings suggest that the construction of the training process for qualified female volleyball players within the preparatory period on the basis of programming promoted statistically reliable ($p < 0.050$) improvements in the following indicators: physical fitness in the limits of 1.90–5.12 %, functional fitness in the limits of 1.43–1.65 %, as well as technical and tactical fitness — by 4.92 %. The results obtained in this study confirm the efficiency of the program developed for the preparatory period of qualified volleyball players and allow to recommend it for practical application in the training process of volleyball teams.

Keywords: program, training task, microcycle, mesocycle, training means, training loads.

Introduction

Modern trends in the development of team game sports dictate the need to find relevant approaches to building and improving the training process (Leibo et al, 2021; Brynzak et al, 2023; Kostiukevych et al, 2019). On the one hand, this is due to a certain stabilization and consolidation of the results of competitive activity, which significantly increases competition both in the national and international arenas (Bezmylov et al, 2022; Sobol et al, 2024; Shlonska, Borysova, Yakusheva, 2024). In addition, the approaches typical of past decades, which involved a constant increase in the volume,

magnitude and intensity of training loads, have exhausted their efficiency, as they have reached certain maximum indicators (Lima et al, 2024; Winther et al, 2024). Thus, a further increase in training loads will be accompanied only by the exhaustion of the functional reserves of the athletes' body (Bompa, Buzzichelli, 2018; Platonov, 2018; Rebelo et al, 2024). Given this, in today's conditions there is an urgent need to optimize the training process at different stages of annual and long-term training (Adamchuk et al, 2023).

Experts consider programming to be one of the most promising areas of optimizing the training process at the present stage, which is considered mainly in terms of programmed learning and training programming (Adamchuk et al, 2022; Hidayah et al, 2024; Shynkaruk et al, 2025). The first approach is based on a motor learning scheme based on a step-by-step algorithm. It allows consistently, on the basis of previously formed motor skills and abilities, to form new ones, gradually complicating the tasks for athletes to bring them to a new level of mastery of technical techniques. Programmed learning is reflected in the works on table tennis (Stasyuk et al, 2021), volleyball (Verbitskiy, Pityn, & Karatnyk, 2023), badminton (Hidayat et al, 2023) and other game sports.

The idea of programming different aspects of training is widely used in sports. In particular, Ihsan et al (2025) conducted a systematic review of studies aimed at the development and implementation of multidirectional strength training programs in order to develop an integrated approach to planning trainings with a focus on the development of muscle strength. In the work of Guo et al (2023), a rowing training program was developed and experimentally substantiated based on modeling of load modes, depending on the characteristics of competitive activity.

Training programs of different duration and focus are actively implemented in the practice of training athletes in game sports (Ihsan et al, 2024). In particular, in the work of Narayanan et al (2025) the influence of a 12-week program of plyometric and Tabata training on the functional state of the cardiovascular system of football players is studied. The study by Türkarslan and Deliceoglu (2024) substantiates the effectiveness of implementing a 6-week plyometric training program for the development of agility, speed and high-speed and power abilities in young football players. The 12-week TRX and plyometric training program developed by Muriyedath et al (2025) is aimed at improving the physical and functional fitness of volleyball players. Irvan et al (2024) suggest a 12-week combined circular Tabata program and study its impact on the physical fitness of young squash players.

At the same time, despite the wide representation of the problem of programming in sports in the existing scientific heritage, we note the narrow focus of the outlined studies, since the generalization of available literature sources showed mainly the accentuated influence of certain means of the outlined programs on certain aspects of the preparedness of athletes. At the same time, an integrated approach to programming of the training process of athletes in team game sports requires a detailed justification (Kostiukevych et al, 2024). Also, a number of advantages testify in favor of the use of the programming method in the construction of the training process, in particular, the possibility of implementing targeted management influences and the formation of training effects due to the clear regulation of the load components (Adamchuk et al, 2021; Shchepotina, Kostiukevych, Asauliuk et al, 2021).

Hypothesis of the research: It was assumed that the construction of structural formations of the training process of qualified female volleyball players within the preparatory period of the annual macrocycle on the basis of programming would contribute to the optimization of training of female athletes by regulating the components of the load and implementing targeted management influences.

The purpose of the research - experimentally to prove the effectiveness of construction of structural formations of the training process for the qualified female volleyball players within the preparatory period of the annual cycle of training on the basis of programming.

Material and Methods

Participants

The experiment involved qualified first category female volleyball players of the student team of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University (n=16), whose average age was (M±SD) 19.56±0.81 years. The research was approved by the Ethics Committee of the Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, and all procedures were in accordance with the Declaration of Helsinki. Informed consent was obtained from the participants to take part in this experiment.

Organization of the Research

The research was carried out during 2023-2024 and included two stages of a sequential pedagogical experiment – ascertaining and formative. During the ascertaining experiment the construction of the training process of the researched qualified female volleyball players within the preparatory period was carried out on the basis of traditional planning. At this stage we carried out the control of means of preparation of female athletes (general preparatory, special preparatory, introductory and competitive) and loads of different orientation (aerobic, mixed aerobic-anaerobic, anaerobic alactate, anaerobic glycolytic) by means of the method of chronometry (Kostiukevych et al, 2019; Shchepotina, Kostiukevych, Asauliuk et al, 2021). At the same time, the amount of training load was determined by the Load Value Coefficient (LVC, points) according to the formula (Adamchuk et al, 2022, 2023; Shchepotina, Kostiukevych, Asauliuk et al, 2021):

$$LVC = \sum t_e \times I_e , \quad (1)$$

where: t_e - exercise duration (min); I_e - exercise intensity (points), depending on the heart rate (114 bpm - 1 point, 120 bpm - 2 points, 126 bpm - 3 points, 132 bpm - 4 points, 138 bpm - 5 points, 144 bpm - 6 points, 150 bpm - 7 points, 156 bpm - 8 points, 162 bpm - 10 points, 168 bpm - 12 points, 174 bpm - 14 points, 180 bpm - 17 points, 186 bpm - 21 points, 192 bpm - 25 points, 198 bpm - 33 points).

The intensity of the training load was determined by the intensity coefficient (IC, points/min) according to the formula (Adamchuk et al, 2021; Shchepotina, Kostiukevych, Asauliuk et al, 2021):

$$IC = \frac{LVC}{T}, \quad (2)$$

where: T is the duration of the training session (min).

The influence of the applied training loads on the preparedness of female players was investigated. In particular, the dynamics of physical fitness indicators was studied by the results of pedagogical testing. The tests recommended by experts as informative were used (Kozina, Polishchuk, Polishchuk, 2023; Sieroń, Stachoń, Pietraszewska, 2023), including, for the definition of the manifestation of high-speed and power abilities – a standing high jump (cm) and a throw of a stuffed ball of mass 1 kg with two hands from behind a head on a distance (kg); for determination of agility in interrelation with speed – shuttle run 30 meters according to the scheme 9-3-6-3-9 m (s); for determination of high-speed endurance in interrelation with agility – a run "herringbone" 92 m (s). The influence on the functional fitness of volleyball players was investigated by the results of morphofunctional diagnostics. The body composition was studied using the OMRON BF 511 (works on the principle of bioelectrical impedance) (Shchepotina, Kostiukevych, Drachuk et al, 2021), which involved determining the percentage (%) of fat and muscle components in the body of female athletes. In addition, an indirect method based on the linear dependence on the indicator of physical performance PWC170, determined by bicycle ergometry, calculated the relative maximum oxygen consumption (VO2max, ml/min/kg) according to the formula (Kostiukevych et al, 2021; Kenney, Wilmore, Costill, 2022):

$$VO_{2\max} = \frac{1.7 \times PWC_{170} + 1240}{m}, \quad (3)$$

where: m - body weight of the volleyball player (kg).

The dynamics of technical and tactical preparedness of volleyball players was studied by the results of pedagogical observation of training games of female athletes with the following determination of the efficiency coefficient of technical and tactical actions (EC, c.u.) according to the formula (Shchepotina, Kostiukevych, Asauliuk et al, 2021; Kostiukevych et al, 2021):

$$EC = \frac{\sum TTA_s}{\sum TTA_t}, \quad (4)$$

where: $\sum TTA_s$ is the sum of successfully performed technical and tactical actions during one game; $\sum TTA_t$ – the total number of technical and tactical actions performed during one game.

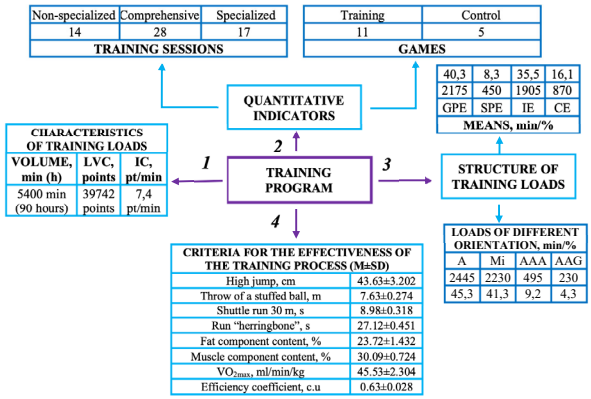


Fig. 1. The program of the training process of qualified volleyball players in the preparatory period: LVC – load value coefficient; IC – intensity coefficient; Means: GPE – general preparatory exercises, SPE – special preparatory exercises, IE – introductory exercises, CE – competitive exercises; Loads of different orientation: A – aerobic orientation, Mi – mixed aerobic-anaerobic orientation, AAA – anaerobic alactate orientation, AAG – anaerobic glycolytic orientation; VO_2max – relative maximum oxygen consumption

The formative experiment envisaged the development and experimental substantiation of efficiency of the introduction of interconnected programs of structural formations of the training process of qualified volleyball players within the preparatory period of the annual macrocycle (programs of the period, meso- and microcycles, training sessions and their parts - training tasks), components of a load in which were developed with an orientation on the directed formation of training effects (urgent, delayed and cumulative) in female athletes. So, the program of the preparatory period of qualified female volleyball players is presented in fig. 1 and included four components: the characteristic and structure of training loads, quantitative and qualitative (criteria of efficiency) indicators of the training process.

The implementation of the offered program of construction of the training process for the qualified volleyball players in the preparatory period was carried out by development and introduction of programs of smaller structural formations - mesocycles (table 1), microcycles, training sessions and tasks (table 2) in which the components of loading - volume, value, intensity, ratio, etc. were clearly regulated.

Thus, the smallest structural unit of programming of the training process of qualified volleyball players was the program of the training task. Accordingly, the programs of training tasks made up the programs of training sessions.

Statistical analysis. The processing of numerical data on indicators of physical, functional and technical and tactical preparedness of the researched qualified female volleyball players at the stages of the pedagogical experiment was carried out on the basis of descriptive statistics (Byshevets et al, 2019; Bai, Bai, 2021; Jones, 2022). The mean value (M) and standard deviation (SD) were determined. Statistical reliability in the difference of indicators of preparedness of sportswomen at the stages of the pedagogical experiment was determined by the parametric Student's t-test. The difference between indicators was considered reliable at $p<0.050$ and $p<0.010$. The preliminary data were checked for compliance with the normal distribution of results by the W-criterion of Shapiro-Wilk.

Results

The processing of data of the ascertaining and formative stages of the pedagogical experiment allowed to compare parameters of training loads. First of all, we note a decrease by 5.7 % (from 5725 to 5400 min) in the volume of training loads in the preparatory period at the formative stage, compared to the ascertaining stage. The load value was also reduced by 4.9 % (from 41804 to 39742 points). However, the intensity of loads increased by 1.4 % from 7.3 pts/min at the ascertaining stage to 7.4 pts/min at the formative stage (fig. 2).

We note the redistribution of training tools (fig. 3). In particular, at the formative stage of the experiment, compared to the ascertaining stage, the share of general preparatory (from 44.0 to 40.3%) and introductory (from 37.3 to 34.3%) exercises was reduced, however, due to this, the share of special preparatory (from 6.8 to 8.3%) and competitive (from 11.9 to 16.1%) exercises was increased.

Table 1. Program for building mesocycles of qualified female volleyball players during the preparatory period

Mesocycles			Retractable	Basic developmental	Control and preparatory	Pre-competitive
Microcycles			1 retractable	1 hitting	ordinary	1 introductory
			2 retractable	2 hitting	hitting	2 introductory
				restorative	restorative	restorative
Characteristics of training loads	Volume, min (hours)		1080 min (18 hours)	1380 min (23 hours)	1440 min (24 hours)	1500 min (25 hours)
	Load value coefficient, points		5941 points	10802 points	11417 points	11582 points
	Intensity coefficient, pts/min		5.5 pts/min	7.8 pts/min	7.9 pts/min	7.7 pts/min
Quantitative indicators of the training process	Training sessions, number	non-specialized	6	3	3	2
		specialized	2	5	6	4
		comprehensive	6	7	6	9
	Games, number	training	1	4	4	2
		control	-	-	1	4
Structure of training loads	Training means	general preparatory, min (%)	655 min (60.6 %)	605 min (43.8 %)	485 min (33.7 %)	430 min (28.7 %)
		special preparatory, min (%)	-	135 min (9.8 %)	205 min (14.2 %)	110 min (7.3 %)
		introductory, min (%)	365 min (33.8 %)	480 min (34.8 %)	510 min (35.4 %)	550 min (36.7 %)
		competitive, min (%)	60 min (5.6 %)	160 min (11.6 %)	240 min (16.7 %)	410 min (27.3 %)
	Loads of different orientation	aerobic, min (%)	730 min (67.6 %)	675 min (48.9 %)	515 min (35.8 %)	525 min (35.0 %)
		mixed aerobic-anaerobic, min (%)	305 min (28.2 %)	520 min (37.7 %)	580 min (40.3 %)	825 min (55.0 %)
		anaerobic alactate, min (%)	45 min (4.2 %)	120 min (8.7 %)	235 min (16.3 %)	95 min (6.3 %)
		anaerobic glycolytic, min (%)	-	65 min (4.7 %)	110 min (7.6 %)	55 min (3.7 %)

Since the level of fitness of volleyball players is also influenced by the distribution of training loads of different orientation, we will compare their ratio at the ascertaining and formative stages of the pedagogical experiment (fig. 4).

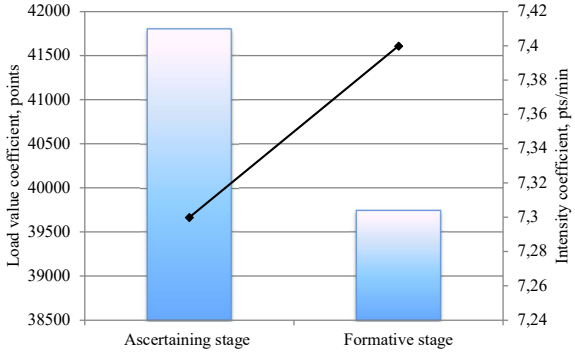


Fig. 2. The total value (points) and average intensity (points/min) of training loads of qualified female volleyball players in the preparatory period at the ascertaining and formative stages of the experiment: – load value coefficient (points); –intensity coefficient (points/min)

In particular, at the formative stage of the experiment, in comparison with the ascertaining one, we note an increase in a share of loads of the mixed aerobic-anaerobic (from 40.9 to 41.3 %), anaerobic alactate (from 5.0 to 9.2 %) and anaerobic glycolytic (from 3.7 to 4.3 %) orientation at the expense of

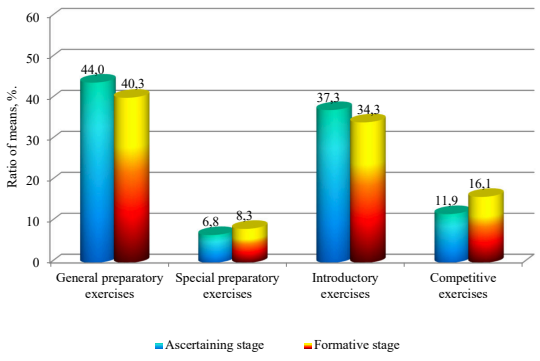
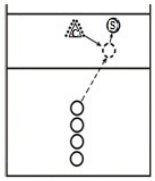


Fig. 3. Correlation of training means of qualified female volleyball players in the preparatory period at the ascertaining and formative stages of the experiment, %

Table 2. Program of training task for improvement of physical fitness of qualified female volleyball players

Content	**Title:** special coordination and speed and power training. **Code:** PT.19. **Objective:** improvement of special coordination fitness of volleyball players in connection with high-speed and power qualities. **Venue**: sports hall. **Form of organization:** team training. The program of the training task is performed in the first half of the main part of the training session in basic mesocycles. It is advisable to perform exercises on both sides of the site to increase motor density. The character of intervals of rest is passive.	 S – setter; C – coach; ○ – player; -→ – direction of movement

Algo-rhythm	Content of the individual steps of the training task program	Components of the load				
		t	I	RI	HR	LVC
1st step	Jumping from a full crouch with a stuffed ball weighing 1 kg in hands. Perform 3 series of 8-10 jumps.	3 min	H-M	45-60 s	174-186 bpm	51 points
2nd step	S.P.: a group of players in a column, one by one, in zone 6, the coach with the balls in zone 3, the binder between zones 2 and 3. The coach throws balls to the front line, which the players in turn have to take in the fall and bring to the binder, who returns the balls back to the coach. Perform 7-10 falls.	5 min 30 s	H	30-45 s	162-174 bpm	66 points
3rd step	Throws of stuffed balls weighing 1 kg in pairs over the net; players are placed on the lines of attack. Perform 10-15 throws.	2 min	H	30-45 s	162-168 bpm	22 points
4th step	Same as step 2, only the coach throws balls to the back line, which the players, moving backward, should take with two hands on top in a low stance with a fall and bring to the binder. Perform 5-7 falls.	3 min 30 s	H	30-45 s	162-174 bpm	42 points
5th step	Walking. Breathing exercises. Preparation for the next task.	1 min	L	-	120-132 bpm	3 points

Training work parameters										
Characteristics of training loads			Structure of training loads							
			Training means, min (%)				Multidirectional loads, min (%)			
Volume, min	LVC, points	IC, pts/min	GPE	SPE	PE	CE	A	Mi	AAA	AAG
15 min	184 points	12.3 pts/min	6 min (40.0 %)	9 min (60.0 %)	-	-	1 min (6.7 %)	11 min (73.3 %)	3 min (20.0 %)	-

Notes: t – time; I – intensity: M – maximum, H – high, L – low; RI – resting intervals; HR – heart rate; LVC – load value coefficient; IC – intensity coefficient; S.P. – starting position; Means: GPE – general preparatory exercises, SPE – special preparatory exercises, IE – introductory exercises, CE – competitive exercises; Loads of different orientation: A – aerobic orientation, Mi – mixed aerobic-anaerobic orientation, AAA – anaerobic alactate orientation, AAG – anaerobic glycolytic orientation

the decrease in a share of loads of the aerobic orientation (from 50.4 to 45.3 %).

An important step on the way to the substantiation of efficiency of programming of the training process for the qualified volleyball players was the definition of dynamics of indicators of preparedness of the researched female athletes under the influence of the applied training loads at the ascertaining and formative stages of the pedagogical experiment. Since indicators of physical, functional, technical and tactical preparedness of the qualified volleyball players at the stages of the pedagogical experiment corresponded to the normal distribution of results of measurements by the W-criterion of Shapiro-Wilk (table 3), it gave us grounds to use the parametric Student's t-test to define statistical reliability in the difference of results.

Comparison of indicators of physical, functional, technical and tactical preparedness of qualified volleyball players obtained at the beginning of the ascertaining stage with the results obtained at the beginning of the formative stage (table 4), showed the absence of significant differences in the display of high-speed and power abilities by female athletes in indicators of a standing high jump ($t = 0.22$; $p = 0.826$) and a throw of a stuffed ball with two hands from behind the head ($t = 0.35$; $p = 0.731$), in a manifestation of agility in interrelation with speed by an index of a shuttle run 30 m ($t = 0.10$; $p = 0.919$), in a manifestation of high-speed endurance in interrelation with agility by an index of a run "herringbone" 92 m ($t = 0.15$; $p = 0.812$), in a component composition of a body weight by indexes of a fat content ($t = 0.37$; $p = 0.714$) and muscular ($t = 1.03$; $p = 0.312$)

Table 3. Determination of conformity to the normal distribution of indicators of physical, functional, technical and tactical preparation of qualified female volleyball players at the ascertaining (AS, n=16) and formative (FS, n=16) stages of the pedagogical experiment

Sl. No	Research indicators	Stage of the experiment	Statistical indicators				
			In the beginning		At the end		Description
			W	p	W	p	
1	A standing high jump, cm	AS	0.954	0.503	0.945	0.371	normal
		FS	0.959	0.580	0.962	0.620	normal
2	Throwing a stuffed ball with two hands from behind the head, m	AS	0.896	0.108	0.921	0.152	normal
		FS	0.917	0.136	0.915	0.122	normal
3	Shuttle run 30 m (9-3-6-3-9 m), s	AS	0.911	0.109	0.922	0.163	normal
		FS	0.920	0.114	0.930	0.214	normal
4	Run "herringbone" 92 m, s	AS	0.980	0.937	0.972	0.827	normal
		FS	0.985	0.982	0.988	0.992	normal
5	Fat component content, %	AS	0.952	0.492	0.949	0.438	normal
		FS	0.919	0.136	0.931	0.228	normal
6	Muscle component content, %	AS	0.924	0.167	0.935	0.254	normal
		FS	0.922	0.165	0.941	0.322	normal
7	VO_2max, ml/min/kg	AS	0.990	0.996	0.971	0.823	normal
		FS	0.959	0.624	0.946	0.410	normal
8	Efficiency coefficient, conventional units	AS	0.968	0.747	0.957	0.521	normal
		FS	0.938	0.272	0.912	0.100	normal

components, in aerobic productivity of an body by the relative index of maximum oxygen consumption (t = 0.15; p = 0.885), in quality of performance of technical and tactical actions by the efficiency coefficient (t = 0.45; p = 0.656). Since the initial results did not differ significantly, it allowed us to continue the pedagogical experiment with obtaining objective data on the efficiency of programming of the training process for the qualified volleyball players.

Repeated measurements carried out at the end of the preparatory period showed significant statistically reliable improvements of the majority of the studied indicators of physical, functional, technical and tactical preparation of qualified volleyball players at the stage of the formative experiment (table 5) when the construction of the training process within the preparatory period was carried out on the basis of programming. In particular, we note the improvement of physical fitness of the researched female athletes by indicators of a standing high jump by 5.12 % (t = 2.24; p = 0.033), a throw of a stuffed ball with two hands from behind a head – by 4.17 % (t = 2.63; p = 0.013), a run "herringbone" 92 m – by 1.90 % (t = 3.39; p = 0.034), functional preparation by indicators of fat component content – by 1.44 % (t = 2.42; p = 0.022), muscle component content – by 1.43 % (t = 3.92; p = 0.000), relative maximum oxygen consumption – by 3.67 % (t = 2.30; p = 0.028), technical and tactical preparation by the coefficient efficiency – by 4.92 % (t = 2.11; p = 0.043).

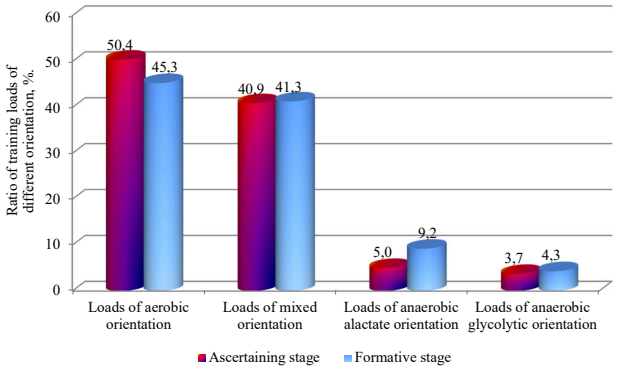


Fig. 4. The ratio of loads of different orientation of qualified female volleyball players in the preparatory period at the ascertaining and formative stages of the experiment, %

During the ascertaining stage of the experiment statistically reliable positive shifts took place in the results of throwing a stuffed ball with two hands from behind the head on average by 3.11 % (t = 2.29; p = 0.029) and the muscle component content in the body of female athletes – by 0.84 % (t = 2.90; p = 0.007).

The obtained results confirm the effectiveness of building structural formations of the training process for the qualified volleyball players within the preparatory period of the annual training cycle on the basis of programming.

Discussion

The generalization of the results of previous studies indicates the prospects of programming the training process of athletes as an alternative to traditional planning, due to the need to regulate the components of the load to optimize

Table 4. Indicators of physical, functional, technical and tactical preparedness of qualified female volleyball players at the beginning of the ascertaining (AS, n=16) and formative (FS, n=16) stages of the pedagogical experiment

Sl. No	Research indicators	Statistical indicators					
		AS		FS		t	p
		M	SD	M	SD		
1	A standing high jump, cm	42.50	3.347	42.75	3.022	0.22	0.826
2	Throwing a stuffed ball with two hands from behind the head, m	7.40	0.306	7.44	0.364	0.35	0.731
3	Shuttle run 30 m (9-3-6-3-9 m), s	9.12	0.313	9.13	0.340	0.10	0.919
4	Run "herringbone" 92 m, s	27.39	0.489	27.37	0.461	0.15	0.812
5	Fat component content, %	24.31	1.494	24.09	1.757	0.37	0.714
6	Muscle component content, %	29.25	0.910	29.60	1.013	1.03	0.312
7	VO_2max, ml/min/kg	45.16	2.375	45.27	2.148	0.15	0.885
8	Efficiency coefficient, conventional units	0.62	0.031	0.61	0.032	0.45	0.656

Table 5. Changes in indicators of physical, functional, technical and tactical preparation of qualified female volleyball players at the stages of the ascertaining (AS, n = 16) and formative (FS, n = 16) pedagogical experiment during the preparatory period

Sl. No	Research indicators	Stage of the experiment	Statistical indicators						
			In the beginning		At the end		ΔM	t	p
			M	SD	M	SD			
1	A standing high jump, cm	AS	42.50	3.347	43.63	3.202	1.13	0.97	0.339
		FS	42.75	3.022	44.94	2.489	2.19	2.24*	0.033
2	Throwing a stuffed ball with two hands from behind the head, m	AS	7.40	0.306	7.63	0.274	0.23	2.29*	0.029
		FS	7.44	0.364	7.75	0.298	0.31	2.63*	0.013
3	Shuttle run 30 m (9-3-6-3-9 m), s	AS	9.12	0.313	8.98	0.318	-0.14	1.25	0.221
		FS	9.13	0.340	8.96	0.301	-0.17	1.57	0.127
4	Run "herringbone" 92 m, s	AS	27.39	0.489	27.12	0.451	-0.27	1.62	0.355
		FS	27.37	0.461	26.85	0.407	-0.52	3.39*	0.034
5	Fat component content, %	AS	24.31	1.494	23.72	1.432	-0.59	1.14	0.142
		FS	24.09	1.757	22.65	1.618	-1.44	2.42*	0.022
6	Muscle component content, %	AS	29.25	0.910	30.09	0.724	0.84	2.90**	0.007
		FS	29.60	1.013	31.03	1.043	1.43	3.92**	0.000
7	VO_2max, ml/min/kg	AS	45.16	2.375	45.53	2.304	0.37	0.45	0.658
		FS	45.27	2.148	46.93	1.909	1.65	2.30*	0.028
8	Efficiency coefficient, conventional units	AS	0.62	0.031	0.63	0.028	0.01	1.01	0.322
		FS	0.61	0.032	0.64	0.039	0.03	2.11*	0.043

Notes: * – the difference in results is statistically reliable at the level of $p<0.050$; ** – the difference in results is statistically reliable at the level of $p<0.010$

training effects and the directed formation of training effects (Stasyuk et al, 2021; Hidayah et al, 2024; Shynkaruk et al, 2025). In contrast to previous studies (Irvan et al, 2024; Muriyedath et al, 2025; Narayanan et al, 2025), which were devoted to the programming of individual aspects of training athletes in team game sports, in our work we reflected the use of a comprehensive system-structural approach to programming, which involves the subordination of programs of smaller structural formations of the training process to larger ones. This approach has been tested in the training process of athletes in track and field all-around (Adamchuk et al, 2022, 2023), field hockey (Kostiukevych et al, 2024), football (Shchepotina, Kostiukevych, Asauliuk et al, 2021) and in the context of our study has confirmed its effectiveness in the practice of preparing qualified volleyball players.

In the course of the conducted research, the data of the existing scientific work (Leibo et al, 2021; Lima et al, 2024; Winther et al, 2024) on the volume, value, intensity, and ratio of loads in the training process of athletes were supplemented and expanded. In particular, according to

Adamchuk et al (2021), reducing the volume of training loads and increasing their intensity made it possible to reach the peak of sports form and to cause additional reserves in the body of athletes. It is especially actual in the context of implementation during the preparatory period of tasks of providing of optimal readiness of the researched volleyball players to loads of the long competitive period. Thus, we consider it expedient to reduce the volume of training loads and increase their intensity at the formative stage of the experiment, in comparison with the ascertaining one.

The training process of qualified volleyball players in the preparatory period at the formative stage of the experiment, in comparison with the ascertaining one, acquired a more pronounced specialized character, which was manifested in a decrease in the share of non-specific (general preparatory) means at the expense of an increase in specific, such as special preparatory and competitive exercises. Such an approach is more typical for the training of qualified athletes, which is consistent with the opinion of Platonov (2018) about the need to increase the specialization of the content of the training process with the growth of athletes' qualifications. In particular, the increase of the share of special preparatory exercises in a complex with the increase of the share of loads of anaerobic alactate and anaerobic glycolytic orientation at the formative stage of the experiment promoted the significant improvement of the display of high-speed and power abilities and speed endurance in interrelation with agility by volleyball players. The increase in the share of competitive exercises contributed to the improvement of the athletes' game practice, which is important for the establishment of group and team interactions (Shlonska, Borysova, & Yakusheva, 2024; Sobol et al, 2024). This, in our opinion, also manifested itself in a significant increase in the technical and tactical preparedness of qualified volleyball players.

The results of the measurements confirmed the expediency of using physical preparedness tests (Kostiukevych et al, 2019; Kozina, Polishchuk, & Polishchuk, 2023), as well as morphofunctional indicators (Shchepotina, Kostiukevych, Drachuk et al, 2021; Bezmylov et al, 2022; Kenney, Wilmore, & Costill, 2022) as criteria for the effectiveness of building training process of female athletes. The existing scientific heritage (Kozina, Polishchuk, & Polishchuk, 2023; Sieroń, Stachoń, & Pietraszewska, 2023; Shlonska, Borysova, & Yakusheva, 2024) was also supplemented with data on the dynamics of indicators of physical, functional, technical and tactical preparedness of qualified volleyball players during the preparatory period.

As for the dynamics of volleyball players' results during the ascertaining stage of the experiment, we note that a statistically significant improvement was found in indicators of throwing a stuffed ball with two hands from behind the head by 3.11 % ($t = 2.29$; $p = 0.129$), which characterizes the manifestation of high-speed and power abilities, and the content of the muscular component in the body of female athletes on average by 0.84 % ($t = 2.90$; $p = 0.007$). This, in our opinion, is due to the specifics of the game activity in volleyball associated with the performance of a large number of jumping and hitting movements, which contributes to the development of high-speed and power abilities and an increase in muscle mass (Shchepotina, Kostiukevych, Drachuk et al, 2021; Shlonska, Borysova, & Yakusheva, 2024).

The absence of statistically significant improvement in indicators of shuttle run of 30 m ($t = 1.57$; $p = 0.127$) in the researched volleyball players during the formative stage of the pedagogical experiment we connect with the influence on this result of the display of high-speed abilities which are difficult to improve in adulthood (Bompa & Buzzichelli, 2018; Platonov, 2018; Kostiukevych et al, 2021). At the same time, we note the positive dynamics of agility in relation to speed in the indicator of shuttle run of 30 m. As for other results the statistically significant improvement of indicators of physical, functional, technical and tactical preparedness of qualified volleyball players during the formative stage of the experiment is noted, and it allows to recommend the offered program of the preparatory period for practical application in the training process of female athletes.

Taking into account that the opinion about the effectiveness of the use of programming in the training process of sportsmen (Guo et al, 2023; Ihsan et al, 2025) has been confirmed in our research, we consider it expedient to continue future searches in the direction of development of programs of competitive and transition periods of qualified volleyball players, and also to study the prospects of programming of stages of long-term improvement in team game sports.

Conclusions

1. Programming of the training process at the present stage is a more progressive form of planning, as it allows to carry out targeted managerial influences on the formation of training effects due to the regulation of components of the training load.

2. The program of the training process of qualified female volleyball players in the preparatory period was developed, which included four components: characteristic of training loads (volume 5400 min, total coefficient of load – 39742 points, average intensity coefficient – 7.4 points/min), structure of training loads (distribution of means: general preparatory exercises – 40.3 %, special preparatory exercises – 8.3 %, introductory exercises – 35.5 %, competitive exercises – 16.1 %; distribution of differently directed loads: loads of aerobic orientation – 45.3 %, mixed aerobic-anaerobic orientation – 41.3 %, anaerobic alactate orientation – 9.2 %, anaerobic glycolytic orientation – 4.3 %), quantitative indicators (the number of training sessions: non-specialized – 14, comprehensive – 28, specialized – 17; the number of games: training – 11, control – 5), criteria of efficiency of the training process (model indicators of physical functional, technical and tactical preparedness).

3. The structure of the program of the preparatory period consisted of the programs of the retractable mesocycle (included programs of two retractable microcycles), the basic developmental mesocycle (consisted of programs of two hitting and one restorative microcycle), the control and preparatory mesocycle (included programs of the ordinary, hitting and restorative microcycles), the pre-competitive mesocycle (consisted of programs of two introductory and one restorative microcycle). In accordance with the system-structural approach, the programs of microcycles made up the programs of training sessions, the structure of which was made up of the programs of training tasks.

4. The construction of the training process of qualified female volleyball players within the preparatory period on the basis of programming promoted statistically reliable ($p < 0.050$) improvement of indicators of physical fitness in the limits of 1.90-5.12 %, indicators of functional fitness in the

limits of 1.43-1.65 %, indicator of technical and tactical fitness – by 4.92 %. The obtained results confirm the effectiveness of the developed program of the preparatory period of qualified volleyball players and allow to recommend it for practical application in the training process of volleyball teams.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Програмування тренувального процесу кваліфікованих волейболісток у підготовчому періоді річного циклу підготовки

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 11 с., 5 табл., 4 рис., 36 джерел.

Мета дослідження – експериментально обґрунтувати ефективність побудови структурних утворень тренувального процесу кваліфікованих волейболісток у межах підготовчого періоду річного циклу підготовки на основі програмування.

Матеріал і методи. В експерименті взяли участь кваліфіковані волейболістки I розряду студентської команди (n=16), середній вік яких становив 19.56±0.81 років. Дослідження проводилося впродовж 2023-2024 рр. і включало два етапи послідовного педагогічного експерименту – констатувальний і формувальний. Формувальний експеримент передбачав розробку й експериментальне обґрунтування ефективності впровадження взаємопов'язаних програм структурних утворень тренувального процесу кваліфікованих волейболісток у межах підготовчого періоду річного макроциклу (програми періоду, мезо- і мікроциклів, тренувальних занять і їх частин – тренувальних завдань). Критеріями ефективності виступали показники фізичної підготовленості (стрибок у висоту з місця, кидок набивного м'яча масою 1 кг двома руками з-за голови на дальність, човниковий біг 30 м за схемою 9-3-6-3-9 м, біг «ялинкою» 92 м), функціональної підготовленості (вміст жирового та м'язового компонентів у тілі, відносне максимальне споживання кисню), техніко-тактичної підготовленості (коефіцієнт ефективності техніко-тактичних дій).

Результати. На формувальному етапі експерименту, порівняно з констатувальним, на 5.7 % (з 5725 до 5400 хв) було зменшено обсяг тренувальних навантажень, на 4.9 % (з 41804 до 39742 балів) знижено величину навантаження, на 1.4 % (з 7.3 до 7.4 бал/хв) підвищено інтенсивність навантажень; зменшено частку загальнопідготовчих (з 44.0 до 40.3 %) і підвідних (з 37.3 до 34.3 %) вправ, однак, за рахунок цього було збільшено частку спеціально-підготовчих (з 6.8 до 8.3 %) і змагальних (з 11.9 до 16.1 %) вправ; збільшено частку навантажень змішаної аеробно-анаеробної (з 40.9 до 41.3 %), анаеробної алактатної (з 5.0 до 9.2 %) й анаеробної гліколітичної (з 3.7 до 4.3 %) спрямованості за рахунок зменшення частки навантажень аеробної спрямованості (з 50.4 до 45.3 %).

Висновки. Побудова тренувального процесу кваліфікованих волейболісток у межах підготовчого періоду на основі програмування сприяла статистично достовірному ($p<0.050$) покращенню показників фізичної підготовленості в межах 1.90-5.12 %, показників функціональної підготовленості в межах 1.43-1.65 %, показника техніко-тактичної підготовленості – на 4.92 %. Отримані результати підтверджують ефективність розробленої програми підготовчого періоду кваліфікованих волейболісток і дозволяють рекомендувати її до практичного застосування в тренувальному процесі волейбольних команд.

Ключові слова: програма, тренувальне завдання, мікроцикл, мезоцикл, тренувальні засоби, тренувальні навантаження.

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