The importance of general physical training in improving the defensive game preparedness of skilled female handball players

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Abstract
This study analyzes the growth dynamics of physical fitness indicators in skilled female handball players. The indicators of the experimental group, which trained according to a specially developed weekly program, improved significantly in all types of tests (running, ball throwing, jumping, endurance) compared to the control group, which trained using traditional methods. The results confirmed the effectiveness of the developed weekly program.
Keywords: handball, skilled female athletes, physical training, growth dynamics, weekly program, speed, strength, endurance.

Introduction

Modern handball is a sport that demands high mobility, quick thinking, and strong physical endurance throughout the game. Particularly in women's handball, the accelerating pace of play and intensifying competition are sharply increasing the demands on athletes' level of general physical preparedness (GPP). The ability of qualified female handball players to achieve high results in competitive activities is directly dependent on how well their functional capabilities and physical qualities (strength, speed, endurance, flexibility) are developed. The effectiveness of the training process is primarily based on the objective assessment of an athlete's level of preparedness and its planned enhancement. From this perspective, it is crucial to regularly monitor the growth dynamics of general physical preparedness indicators in qualified female handball players and to identify the patterns of their development in accordance with their age and skill characteristics. This study is specifically aimed at analyzing the gradual changes in these indicators and evaluating the effectiveness of the existing training system.

The dynamic evolution of handball, the universalization of players (the ability to perform equally well in both defense and attack), and the increasing number of games have fundamentally changed the demands on athletes' physical fitness. Today, a skilled female handball player must possess not only technical and tactical mastery but also excellent physical conditioning to maintain high intensity until the final minutes of the game. The relevance of this topic is explained by the following: The level of general physical fitness is one of the key factors determining an athlete's future potential. By studying the dynamics of these indicators, coaches can more accurately select talented athletes and develop individualized approaches for them. Analyzing the growth dynamics of these indicators makes it possible to determine the effectiveness of the applied training loads. If the growth of indicators slows or stagnates at a certain stage, this signals the need to make adjustments to the training program. In modern sports, an approach based on precise data and scientific analysis is taking precedence over intuitive knowledge. Data on the training dynamics of skilled athletes serves as an important guide for the coaching staff. Therefore, researching the growth dynamics of general physical fitness indicators in skilled female handball players is a theoretically and practically significant issue, which will contribute to the development of Uzbek handball and enhance its competitiveness in the international arena.

Analysis of Scientific Literature on the Topic. A study by Haugen et al. (2025) was dedicated to examining the long-term training process of a world-class female handball player. This work, conducted by Norwegian researchers, analyzed the dynamics of the athlete's training from age 7 to 34. The study found that the volume of physical training increased progressively: from 50 to 300 hours per year between the ages of 7 and 15, then rising to and remaining at 600 hours per year. Within the physical training regimen, strength training accounted for 80-90%, while endurance training comprised 10-20%.

In their research, Michalsik et al. (2014-2015) studied the on-court performance and physiological capabilities of elite female handball players. These studies established that in women's handball, the average heart rate during

Table 1. Comparative statistical analysis of the general physical preparedness level indicators of skilled female handball players at the beginning of the study

No.	Test	Control group (CG)		Experimental Group (EG)		t	P
		± σ	V, %	± σ	V, %		
1.	30m sprint (seconds)	4.8±0.33	6.84	5.1±0.47	9.21	1.78	>0.05
2.	Throwing a 1 kg ball for distance (meters) Left hand	8.9±0.50	5.60	8.6±0.79	9.26	1.19	>0.05
	Right hand	15.8±2.15	13.56	15.2±0.86	5.65	1.17	>0.05
3.	Standing triple jump (meters)	5.8±0.45	7.88	5.4±0.42	7.73	1.87	>0.05
4.	6-minute Cooper test (meters)	1376.6±78.4	5.95	1319.6±78.5	5.69	1.78	>0.05

a game is 86% of the maximum, and field players cover an average distance of 3000-5000 meters. The researchers also noted that physical demands vary depending on playing positions: back-line players perform more throws, wingers engage in fast breaks, and line players participate in intense physical contests [1,2,3].

A systematic analysis of physical and physiological factors in women's handball was conducted by Granados et al. (2013). The study established that elite female handball players are tall athletes with a high fat-free body mass (FFM), and that athletes with high aerobic endurance have an advantage in international competitions. It was also noted that strength and explosiveness exercises are correlated with sprint performance and ball-throwing velocity [4].

Garcia-Sanchez et al. (2024) studied the influence of contextual factors on the physical demands in women's handball. The study found that factors such as game status, opponent strength, and match location significantly influence the athletes' physical performance [5].

Perez Armendáriz et al. (2024) conducted a comprehensive analysis of the game demands in women's team sports. This work systematized the movement activity, cardiovascular system responses, and energy supply mechanisms of female handball players during a game [6].

A study by Pavlov Shoislom Kallibaevich (2021) examined the means for developing endurance qualities in female handball players, methods of monitoring, and the methodology for endurance training. The research analyzed endurance development methods such as uniform-pace exercises (pulse ≤130 beats/min),

Table 2. 1-week training program

Day	Training Focus	Warm-up (10-15 min)	Main Exercises	Reps / Distance	Cool-down
Monday	Strength Training	800 m light run, dynamic stretching	Squat, Push-up, Abdominal Crunches, Jump Rope, 30 m Sprint	4×12, 4×15, 4×20, 5×1 min, 6 reps	Stretching
Tuesday	Speed and Agility	10 min run, mobility exercises	Zig-zag Run, Shuttle Run (4×10 m), Lateral Jumps	6×20 m, 6 reps, 4×15	Breathing exercises
Wednesday	Endurance	10 min run	1500-2000 m cross-country run, 200 m interval run, Abdominal Crunches, Plank	1 rep, 6 reps, 4×25, 3×1 min	Stretching
Thursday	Plyometric Training	10 min run, jumping drills	Box Jump, Long Jump, Lateral Jumps, 20 m Sprint	4×10, 4×8, 4×12, 8 reps	Stretching
Friday	Complex Training	10 min run	Burpee, Push-up, Squat, Jump Rope, Shuttle Run	3-4 circuits	Recovery exercises
Saturday	Active Recovery	Light jog or swim	Stretching exercises	20-30 min	Relaxation
Sunday	Rest	-	Complete rest	-	-

Table 3. Comparative statistical analysis of the general physical fitness level indicators of qualified female handball players at the end of the experiment

No.	Test		Control Group (CG)		Experimental Group (EG)		t	P
			± σ	V, %	± σ	V, %		
1.	30 m dash (seconds)		4.6±0.44	9.61	4.3±0.27	6.35	1.88	<0.05
2.	1 kg ball throw for distance (meters)	Left hand	9.5±0.73	7.61	10.3±0.65	6.31	2.76	<0.01
		Right hand	16.1±0.56	3.50	16.9±1.23	7.26	2.14	<0.05
3.	Standing triple jump (meters)		6.0±0.11	1.83	6.2±0.18	2.93	4.04	<0.001
4.	6-minute Cooper test (meters)		1393.6±43.83	3.15	1426.8±31.65	2.22	2.13	<0.05

variable-pace exercises (maximum pulse 180 beats/min), the interval method, and the competitive method. A comparison of the results between the experimental and control groups showed a relative growth difference of 5.23%. The researcher also conducted work on injuries in handball players and ways to prevent them [7].

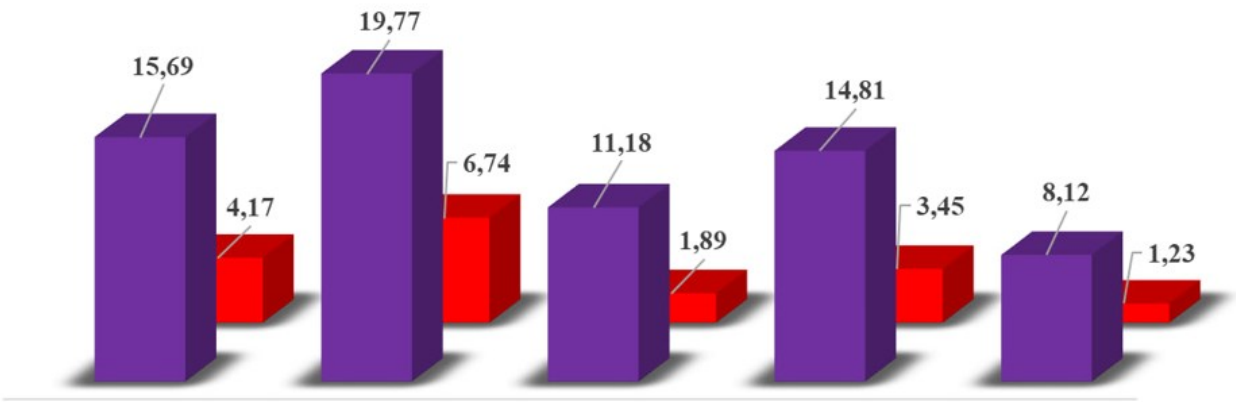
Khurshida Karimovna Berdieva (2023) studied the effectiveness of dynamic games in increasing the motor activity of 10-11-year-old female handball players. The research revealed that the average distance covered during a single game increased from 1292.58 meters to 1339.36 meters, and the number of movement actions increased from 1812.36 to 1871.36. At the most intense point of the game, the average heart rate decreased from 187.44 to 183.54 beats/min. During the experiment, the average step length improved by 3.16%, total distance by 3.62%, and movement actions by 3.20% [8].

Tulaganov Sh.F., Abdurahmanov F.A., Pavlov Sh.K., Kariyeva R.R., Isroilov R.I., and Muminov A.Sh. (2020) studied injuries in handball players and methods for their prevention. In this study, the types of typical injuries found in handball players were identified, and recommendations for their prevention were developed [9].

Beisenova Aizada (2025) analyzed the training sessions of young handball players. The study emphasizes the need to find increasingly sophisticated means and methods for training handball players in the context of intensifying competition in world handball, as well as paying special attention to the issue of considering sexual dimorphism in athlete training [10].

Denisova U.J. and Masharipova R.Yu. (2019) studied the correlation between the morphometric features of body composition and physical fitness indicators in female basketball players aged 16-18. This research contributes to understanding the patterns of physical development in girls who engage in ball sports [11].

Fig. General physical fitness indicators of female handball players



Note: **From left to right: 30 m run (s) 1 kg ball throw (left hand) (m)"; 1 kg ball throw (right hand) (m); Standing triple jump (m); 6-minute Cooper test (m);* Experimental group; Control group

Foreign research primarily focuses on the long-term training dynamics of elite female handball players, position-specific characteristics, modern game requirements, and the use of high-tech measurement tools. Specifically, a longitudinal study by Haugen et al. (2025) illuminated the training dynamics of a single athlete throughout her entire career, while Fristrup et al. (2024) developed benchmark indicators for elite athletes using the Danish national team as a case study.

In contrast, local research is mainly centered on the initial training stages of young female handball players, the development of physical qualities through dynamic games, methods for building endurance, and injury prevention. Studies conducted by Pavlov (2021) and Berdiyeva (2023) are of practical importance and can serve as manuals for coaches. While foreign studies employed modern measurement tools (force platforms, portable dynamometers, dual-beam photocells) and complex statistical analyses, local studies utilized relatively traditional methods such as pedagogical observation, pulsometry, and simple statistical techniques. Nevertheless, the research by local scientists is significant for its adaptation to the national contingent and its applicability in local conditions.

Objective of the study: To determine the indicators of the general physical preparedness level of skilled female handball players, to analyze their growth dynamics, and to substantiate effective methods and tools aimed at developing physical qualities during the training process.

Results and discussion

The research results can be applied to improve the handball training process. The developed system of exercises is recommended for use in the process of training female handball players at sports schools, higher education institutions, and sports clubs.

The obtained results serve as a methodological guide for coaches. The research materials can be used in the educational process in the field of physical education and sports.

This table shows the baseline results for general physical preparedness of skilled female handball players at the beginning of the study.

A mathematical-statistical analysis of the general physical preparedness indicators for the control and experimental groups, obtained at the start of the study, showed the following: for the skilled female handball players in the control group, the 30-meter sprint test yielded an arithmetic mean of 4.8, a standard deviation of 0.33, and a coefficient of variation of 6.84%. For the female handball players in the experimental group, the same test produced an arithmetic mean of 5.1, a standard deviation of 0.47, and a coefficient of variation of 9.21%. The theoretically calculated t-value for Student's distribution at a significance level of P was 1.78, with $P>0.05$, indicating that the difference was not statistically significant.

For the qualified female handball players in the control group, the average arithmetic mean for the 1-kilogram ball left-hand distance throw (meters) test was 8.9, the standard deviation was 0.50, and the coefficient of variation was recorded at 5.60%. For the female handball players in the experimental group, the average arithmetic mean for the same test was 8.6, the standard deviation was 0.79, and the coefficient of variation was 9.26%. The theoretically calculated t-criterion value of the Student's t-distribution for the p-value was recorded as 1.19, with $P>0.05$, where the significance level was deemed not statistically significant.

For the qualified female handball players in the control group, the average arithmetic mean for the 1-kilogram ball right-hand distance throw (meters) test was 15.8, the standard deviation was 2.15, and the coefficient of variation was recorded at 13.56%. For the female handball players in the experimental group, the average arithmetic mean for the same test was 15.2, the standard deviation was 0.86, and the coefficient of variation was 5.65%. The theoretically calculated t-criterion value of the Student's t-distribution for the p-value was recorded as 1.17, with $P>0.05$, where the significance level was deemed not statistically significant.

For the standing triple jump test (in meters), the qualified female handball players in the control group recorded an arithmetic mean of 5.8, a standard deviation of 0.45, and a coefficient of variation of 7.88%. The female handball players in the experimental group recorded an arithmetic mean of 5.4, a standard deviation of 0.42, and a coefficient of variation of 7.73%. The theoretically calculated Student's t-test value for the P significance level was 1.87, with $P>0.05$, which was evaluated as not statistically significant.

For the 6-minute Cooper test (in meters), the qualified female handball players in the control group recorded an arithmetic mean of 1376.6, a standard deviation of 78.4, and a coef-

ficient of variation of 5.95%. For the same test, the female handball players in the experimental group recorded an arithmetic mean of 1319.6, a standard deviation of 78.5, and a coefficient of variation of 5.69%. The theoretically calculated Student's t-test value for the P significance level was 1.78, with P>0.05, which was evaluated as not statistically significant.

Based on the analysis of experimental results from the initial stage of the study, a one-week program was developed to increase the general physical fitness level of skilled female handball players, which we then implemented on a trial basis in practical training sessions.

The developed training program is aimed at the comprehensive development of strength, speed, agility, and endurance in qualified female handball players and is based on modern sports training theory and the results of scientific research. This program was consistently implemented with female handball players over a 6-month period, resulting in a positive growth dynamic in their general physical fitness indicators.

This table presents the general physical fitness results of the qualified female handball players at the conclusion of the study.

A mathematical-statistical analysis of the general physical fitness indicators of the control and experimental groups, obtained at the end of the study, showed the following for the 30-meter run (seconds) test: the average arithmetic value for the qualified female handball players of the control group was 4.6, the standard deviation was 0.44, and the coefficient of variation was 9.61%. For the female handball players of the experimental group, the average arithmetic value was 4.3, the standard deviation was 0.27, and the coefficient of variation was 6.35%. The theoretically calculated Student's t-test value for the P significance level was recorded at 1.88, which constituted P<0.05, where the significance level was deemed reliable.

For the test of throwing a 1-kilogram ball for distance with the left hand (meters), the average arithmetic value from the qualified female handball players of the control group was 9.5, the standard deviation was 0.73, and the coefficient of variation was 7.61%. For the female handball players of the experimental group, the average arithmetic value was 10.3, the standard deviation was 0.65, and the coefficient of variation was 6.31%. The theoretically calculated Student's t-test value for the P significance level was recorded at -2.76, while P<0.01, where the significance level was deemed reliable.

For the qualified female handball players in the control group, the "1 kg ball throw for distance with the right hand (meters) " test recorded an arithmetic mean of 16.1, a standard deviation of 0.56, and a coefficient of variation of 3.50%. For the female handball players in the experimental group, the same test yielded an arithmetic mean of 16.9, a standard deviation of 1.23, and a coefficient of variation of 7.26%. The theoretically calculated Student's t-test value for the p-value was 2.14, with P<0.05, where the significance level was deemed reliable.

For the qualified female handball players in the control group, the "standing triple jump (meters) " test recorded an arithmetic mean of 6.0, a standard deviation of 0.11, and a coefficient of variation of 1.83%. For the female handball players in the experimental group, the same test yielded an arithmetic mean of 6.2, a standard deviation of 0.18, and a coefficient of variation of 2.93%. The theoretically calculated Student's t-test value for the p-value was 4.04, with P<0.001, where the significance level was deemed reliable.

For the qualified female handball players in the control group, the 6-minute Cooper test (in meters) yielded an arithmetic mean of 1393.6, a standard deviation of 43.83, and a coefficient of variation of 3.15%. For the female handball players in the experimental group, the standing triple jump test (in meters) yielded an arithmetic mean of 1426.5, a standard deviation of 31.65, and a coefficient of variation of 2.22%. The theoretically calculated t-value of the Student's t-distribution for the P significance level was recorded as 2.13, resulting in P<0.05, where the significance level was deemed unreliable. Based on the relative growth results shown in the diagram above, it can be stated that the 1-week training program significantly improved the speed, strength, explosive power, and endurance indicators of the qualified female handball players. The experimental group demonstrated considerably higher results in all tests compared to the control group, with improvements of 15.69% in the 30m run, 19.77% in the 1kg ball throw with the left hand, 11.18% with the right hand, 14.81% in the standing triple jump, and 8.12% in the 6-minute Cooper test. These findings indicate that a short-term, yet intensive and comprehensive, training program can effectively enhance the general physical fitness of athletes,

and this effectiveness is clearly confirmed by the results of the experimental group.

Conclusion

A statistical analysis of the test results conducted at the end of the experiment showed that the girls in the experimental group (EG), who trained according to a specially developed one-week program, significantly outperformed the control group (CG) in all indicators of physical fitness. In all types of tests (30-meter sprint, distance ball throw, standing triple jump, and the Cooper test), the results of the experimental group were higher, and these differences are considered statistically significant ($P < 0.05$; $P < 0.01$; $P < 0.001$). Notably, the highest level of significance ($P < 0.001$) was recorded in the "standing triple jump" test, which reflects explosive power. Furthermore, the low coefficient of variation (V%) in the experimental group indicates that the fitness level within the group had stabilized and become more uniform. The effectiveness of the one-week program is attributed to the proper distribution of workloads throughout the week (with speed, strength, and endurance exercises sequenced), and the inclusion of handball-specific movements (two-handed throws, jumps, accelerations) alongside general physical training. This led to the simultaneous and harmonious development of the athletes' speed, strength, endurance, and agility. In conclusion, the developed one-week program served as an effective tool for improving the overall physical fitness of skilled female handball players and is recommended for practical application.

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