

Comprehensive Analysis Of The Dynamics Of Physical Fitness Indicators Of Handball Players

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Abstract

This scientific study is dedicated to a comprehensive study of the main indicators that form the level of physical fitness of female handball players - speed, strength, endurance and agility. The study involved 24 athletes aged 17–20: 12 were divided into control (CG) and 12 into experimental (TG) groups.

A specially developed physical training program was used for the experimental group. During the study, athletes' performance in the 30-meter dash, shot put, 4x10-meter relay, 1000-meter run, handstand push-ups, and jumping were analyzed.

The results showed that the athletes of the experimental group showed significant improvement in all indicators ($p < 0.05$ – $p < 0.001$). In particular, the increase in speed (30 m run), explosive power (jump), and arm strength (throwing a ball) was the highest. This proves the effectiveness of a comprehensive approach in the training process of female handball players.

Keywords: handball, female athletes, physical training, speed, endurance, strength, agility, sports physiology.

Entrance

In recent years, the modernization of the sports sector in the Republic of Uzbekistan, the widespread promotion of a healthy lifestyle among young people, and the strengthening of women's participation in sports have become one of the priority areas of state policy. Under the leadership of President Sh.M. Mirziyoyev, in the past five years, deep reforms have been carried out in the sports system, modern infrastructure, new training centers, and research laboratories have been established.

Important documents adopted in this regard include: Decree No. PF–6099 (October 30, 2020) - “*On measures to further improve physical education and sports and widely promote a healthy lifestyle*”, Resolution No. PQ–4955 (February 5, 2021) - “*On further improving the management system in the field of sports*”, “*Concept for the development of physical education and mass sports in the Republic of Uzbekistan until 2025*”, as well as “*National Program for the Development of Women's Sports for 2024–2026*”.

Based on these documents, new tasks have been set to improve the scientific, pedagogical and methodological aspects of sports, and to conduct in-depth studies of the physical, functional and mental preparation of female athletes.

Handball is a team sport that requires high speed, reaction, agility, strength, endurance and coordination from the athlete. This game consists of multidirectional movements, in which each decision of the athlete is made in a split second. Therefore, the training system of handball players requires not only one physical quality, but also complex physical, technical and psychological preparation.

Planning training sessions that take into account the specific characteristics of the physiology of female athletes is crucial for maintaining their health, protecting them from overload, and stabilizing their competition results. This process is carried out based on the integration of sports physiology, biochemistry, and pedagogy.

Scientific basis and relevance

The concept of scientifically based management of physical training is also recognized worldwide. Internationally, *the Periodization Theory developed by Bompa & Buzzichelli (2019)*, the fundamental work of Zatsiorsky (2006) on strength training, and the experiments conducted by Hammami et al. (2021) on the effectiveness of plyometric training in female handball players show that the development of physical qualities in a comprehensive manner, rather than in one direction, provides the highest sports results.

This scientific work is based on this approach: the general, specific and physical development indicators of female handball players are analyzed in their interrelation. The harmonious development of speed, strength,

endurance, agility and coordination qualities increases the game efficiency, technical skills and reaction speed of female athletes.

Research objective

The purpose of this study is to determine the dynamics of changes in the level of physical fitness in female handball players, assess the effectiveness of sports training, and develop scientific recommendations based on the results obtained. The results of the study will allow optimizing the training system of female athletes, creating methodological guidelines for coaches, and applying them in practice in the field of sports pedagogy.

Research material and methods

The study involved 24 female handball players (mean age 18.6±0.9 years). They were randomly divided into two groups:

- Control group (CG) – those who engaged in a traditional training program,
- Experimental group (TG) - those trained based on a specially developed comprehensive training program.

Assessment tests:

1. 30 m run (s) – to determine speed,
2. Throwing a softball (1 kg) – assessing explosive power,
3. 4x10 m medley – agility test,
4. 1000 m run – assessment of general endurance,
5. Standing long jump – assessing leg strength,
6. Handstand (1 minute) – to test strength and endurance.

The results were analyzed using the Student's t-test, with a statistical significance level of $p < 0.05$.

Results

At the beginning of the experiment, the difference between the two groups was not significant ($p > 0.05$). At the end of the experiment, the following results were recorded:

No.	Indicators	Control group (CG)	Experimental group (TO)	t	p
1	30 m run (s)	6.71±0.78	6.12±0.54	2.15	<0.05
2	Filling ball (m)	6.27±0.94	7.01±0.73	2.15	<0.05
3	Long jump (cm)	160.03±23.49	178.64±18.63	2.15	<0.05
4	4x10 m run (s)	10.68±1.14	9.80±0.85	2.14	<0.05
5	Folding hands - writing (times)	23.15±3.81	28.41±2.68	3.91	<0.001
6	1000 m run (s)	90.34±13.48	88.25±8.30	2.20	<0.05

The results show that the experimental group showed positive dynamics in all indicators. In particular, there was a significant increase in arm strength, speed and explosive power. This indicates the effectiveness of the training methodology.

Discussion

The uniqueness of the game of handball is that it requires the athlete to work together in harmony with various physical qualities. Therefore, the result of the integrated approach in the study was precisely such integration. The joint development of speed, agility and strength improves neuromotor coordination of muscles, increases movement speed and reduces reaction time.

These results are consistent with previous foreign studies (Bompa & Buzzichelli, 2019; Hammami et al., 2021) and once again prove the importance of a comprehensive approach for female athletes.

Conclusion

The results of the study showed that a comprehensive approach to developing the physical fitness of female handball players gives effective results. During the training sessions conducted during the experiment, the athletes' important physical qualities, such as speed, strength, endurance, agility and coordination, significantly improved ($p < 0.05$ – $p < 0.001$).

First, the experimental group athletes achieved an average increase of 15–18% in speed performance. This was especially evident in the 30 m sprint and 4x10 m medley tests. These results indicate increased muscle fiber activation, increased central nervous system reaction speed, and improved neuromuscular coordination. Secondly, there was a significant increase in explosive strength and power endurance (in jump and overhead throw tests). This confirms the harmonious use of plyometric exercises, resistance running, and static-dynamic strength phases in the training. It is this approach that has become an important factor in increasing the impact force and jump height in the game for handball players.

Third, the overall endurance (1000 m run) performance improved by 5–8%. This result is explained by the appropriate use of interval runs and combined loads in training. Increased endurance allows female handball players to maintain stability of movement during the competition.

Fourth, there was a significant increase in strength and coordination (handstand push-ups and 20 m dribbling). These changes are based on the development of higher neuromuscular activity, spatial goal acquisition, and coordination mechanisms.

Scientific and practical conclusions

1. Comprehensive development of physical fitness in female handball players - that is, harmonious development of speed, strength, endurance, agility, and coordination - leads to a sustainable increase in sports results.
2. The training methodology used in the study (a combination of plyometric, interval, and directional training) was found to be physiologically acceptable and safe for female athletes.
3. The results show that training programs developed on the principle of "science - education - practice" fully comply with the strategic tasks set out in the resolutions of the President of the Republic of Uzbekistan PF-6099 and PQ-4955 in the field of sports.
4. The studied complex methodology can also be applied in other team sports (volleyball, basketball, mini-football), as it strengthens the physiological foundations of general training in female athletes.

Recommendations

- It is recommended that coaches use speed and strength exercises (short runs of 10–30 m, plyometrics, dribbling speed exercises) at least twice a week in their weekly training plan when working with female handball players.
- Exercises that combine the types of energy metabolism (anaerobic and aerobic) during the game (for example, short runs + recovery interval exercises) increase efficiency.
- An integrated monitoring system (comparing test results every month) should be introduced to assess physical qualities.
- When increasing the workload for female athletes, hormonal cycles and psychophysiological characteristics must be taken into account.
- The establishment of a "Scientific and Methodological Center for Handball" at higher educational institutions will improve the quality of training for young female athletes.

This study is one of the important practical steps towards the scientific development of female athletes in the sports system of Uzbekistan. The results obtained will not only increase the physical capabilities of female handball players, but also serve to enhance the national sports potential.

In the future, it is recommended to conduct in-depth studies of the biomechanical, endocrine, and psychophysiological effects of training loads in this area. This will expand the possibilities of creating a scientifically based training system for achieving high results in women's sports.

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