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Development of an Endurance Training Program to Meet the Criteria of Female Football Players in Junior High Schools

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Abstract

Background and Aim: The purpose of this study is to develop a set of endurance training programs to improve the endurance capacity of junior high school female football players. The purpose of this study is: 1) to develop endurance training program for junior high school female football players; 2) Compare the average difference between junior high school female football players and the standard maximum endurance and speed endurance; 3) Compare the P-values of maximum endurance and speed endurance of junior high school female football players before, during and after the test.

Materials and Methods: In this study, 20 junior high school female football players from the Dongfeng Middle School Club in Langzhong City, Sichuan Province, were divided into the test group by the method of experimental design. An independent sample t-test was used for data analysis, and the significance level was $P < 0.05$.

Results: The results show that compared with the criterion, junior high school female football players have a significant improvement in endurance, including maximum endurance and speed endurance. There were significant improvements in the assessment. The purpose of this study is to develop a set of endurance training programs to improve the endurance capacity of junior high school female football players. The purpose of this study is: 1) to develop an endurance training program for junior high school female football players; 2) to compare the average difference between junior high school female football players and the standard maximum endurance and speed endurance; 3) to compare the P-values of maximum endurance and speed endurance of junior high school female football players pre-test, mid-test post-test.

Materials and Methods: In this study, 20 junior high school female football players from the Dongfeng Middle School Club in Langzhong City, Sichuan Province, were divided into the test group by the method of experimental design. An independent sample T test was used for data analysis, and the significance level was $P < 0.05$.

Results: The results show that compared with the criterion, junior high school female football players have a significant improvement in endurance, including maximum endurance and speed endurance. There were significant improvements in the assessment pre-test, mid-test post-test, indicating that the training regimen was effective in improving endurance capacity, such as maximum endurance and speed endurance.

Conclusion: Development of an endurance training program to meet the criteria of female football players in junior high school players, indicating that the training regimen was effective in improving endurance capacity, such as maximum endurance and speed endurance.

Keywords: Maximum Endurance; Speed Endurance; Junior High Female Football Player; Criteria

Introduction

Endurance is very important for junior high school female football players, as it not only relates to the players' continuous capacity in the game, but also directly affects their physical recovery and players' capacity improvement. In football matches, football players need to run and fight with high intensity for a long time, which requires football players to have strong endurance and be able to maintain a stable competitive state in the late stage of the game to avoid movement errors or physical decline due to fatigue. Good endurance training can effectively improve the heart and lung function, enhance muscle endurance, and help football players in the field more durably play. In addition, endurance training can also improve the recovery ability of football players, reduce fatigue and injury caused by long-term exercise, so as to maintain a better competitive state and physical fitness level. (Zhang,2002), mentioned that endurance training requires progressive training load, scientific training cycle arrangement, personalized training programs, and diversified training methods. Mentally, endurance training can help football players maintain focus and perseverance in the face of prolonged physical exertion, enhancing their mental toughness and enabling them to persevere under pressure. Therefore, endurance training is not only vital to the

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improvement of the physical quality of football players, but also helps football players to maintain stable ability in the game and improve the competitive level.

At present, the endurance training of junior high school female football players lacks targeted training programs, does not fully consider the physiological and developmental characteristics of junior high school female football players, and lacks specific needs of female football design. (Guo,1997). Physiological analysis of training methods to improve the aerobic capacity of football players points out that the current endurance training often adopts general methods, lacking training content and load arrangement specifically designed for female football players, thus affecting the maximization of training effect. To improve the aerobic capacity of football players, scientific training methods should be combined, such as interval training, continuous training, and high-intensity training. And adjust according to the individual differences of players. (Wang etal.,2023). Research on the status quo and improvement of physical training for young football players. It is pointed out that the research on the endurance training of adult players is quite abundant, while the specialized research on the endurance training of young female football players is relatively few. This research gap makes the coaches lack sufficient theoretical guidance to formulate scientific and effective training programs. In addition, due to physiological differences, there are also significant differences in the needs and characteristics of male and female players in terms of endurance development.

Therefore, to solve the current problems and improve the performance of speed endurance and maximum endurance of junior high school female football players, to improve the overall performance of these players, this study puts forward a targeted training program, which fills the gap in the research background. Strengthen the intensity of training projects and improve the design of training programs. According to the physiological differences and gender characteristics of female players, scientific training programs are formulated to improve the intensity and effect of training, and ensure that the endurance level of female players meets the required standard. At the same time, this study will provide a scientific basis and practical guidance for coaches, which will help to optimize the training program and improve the physical quality and competition ability of players.

Objectives

The purpose of this research is to find out as follows:

Main objective

1. To develop of endurance training program to meet the criteria of female football players in junior high school.
2. To study the current problem of endurance training programs for female football players in junior high school.
3. To draft the endurance training program to meet the criteria of female football players in junior high school.
4. To experiment with the endurance training program of female football players in junior high school.

Literature review

Endurance capacity: Maximum endurance training is training to increase aerobic endurance, lactate threshold, and VO2max at an intensity close to an individual's ultimate endurance level. This training method is suitable for pushing the endurance limits of players, especially in sports such as football that require high intensity and sustained movement. Endurance is actually the performance of an individual's comprehensive ability to resist fatigue during activities. In general, this is commonly referred to as fatigue resistance. Resistance: The internal resistance of an organism to fatigue during prolonged exercise. If a player can effectively overcome the fatigue of the body in the game or training, then his continuous game or training time will be relatively extended, which indicates that he has a high maximum endurance capacity. Research shows that maximum endurance is embodied in an individual's ability to continue to

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overcome difficulties in the face of fatigue challenges at work. There are many aspects to this fatigue, including mental fatigue, sensory fatigue, emotional fatigue, and physical fatigue. He pointed out that the so-called endurance quality is the ability to resist physical fatigue caused by muscle activity during exercise, which highlights the particularity of sports training (Guo,1986).

Speed endurance refers to the ability to maintain a certain amount of time or repetition of exercise at high intensity or near maximum speed. It combines the qualities of speed and endurance, usually involving short periods of high-intensity exercise, and emphasizes the ability to recover quickly and delay fatigue. We believe that football players should retrain their special physical qualities when they practice their full body quality. In the practice of specialized body elements, focus on practicing good speed and quality. The speed quality of football players refers to the speed of thinking, measuring, and judging, reaction speed, technical movement, and habitual speed and running speed (including stopping, starting, shifting, changing direction, turning, etc.). In the competition, every movement should be fast and agile, and its ring section mainly has the following three points: 1) The choice of visual response, that is, the process of thinking and judgment; 2) The ability to speed up in different directions, that is, the size of the explosive force; 3) The ability to complete the movement with the fastest frequency, namely the continuous habitus and rhythmic sense of skill and skill (Cheng, 1982).

Female football players: A Junior girls' football player is a female student player, usually between the ages of 12 and 15, who is trained in football at the junior high school level and represents their school or club in competition. (Ning, 2021) research points out that junior high school girls' football training should follow the following principles: First, pay attention to the cultivation of interest, and stimulate girls' enthusiasm for football through interesting activities; The second is to combine the physical (weak strength, good flexibility) and psychological (easily defeated, afraid of injury) characteristics of girls, adjust the intensity and content of training; Third, step by step, gradually improve the difficulty of training, to ensure the criteria technical movements.

Principles of endurance training for female football players in junior high school: Based on the general principles outlined in the book (Tian, 2006), training programs suitable for junior high school students should include the following

1) Training frequency: It is recommended to train 3-5 times per week to ensure sufficient recovery time.

2) Training duration: Each training session is controlled between 45 minutes and 1.5 hours.

3) Training load: According to the physical fitness level of students, gradually increase the training load, starting from low intensity, transition to medium intensity, and appropriately introduce high-intensity training.

4) Intensity classification: The training intensity can be divided into three levels: low (50%-60% of the maximum heart rate), medium (60%-80% of the maximum heart rate), and high (80%-90% of the maximum heart rate).

Criteria of female football players in junior high school:

General value model table of special quality of junior high school female football players (Liu & Guo,2014)

Category	Unit	x̄	S.D.
12-minute run	m	1956	207
10 meter race	s	2.16	0.17
30 meter race	s	5.17	0.22
60-meter race	s	9.63	0.59
5× 25m return runs		32.79	1.20

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Conceptual Framework

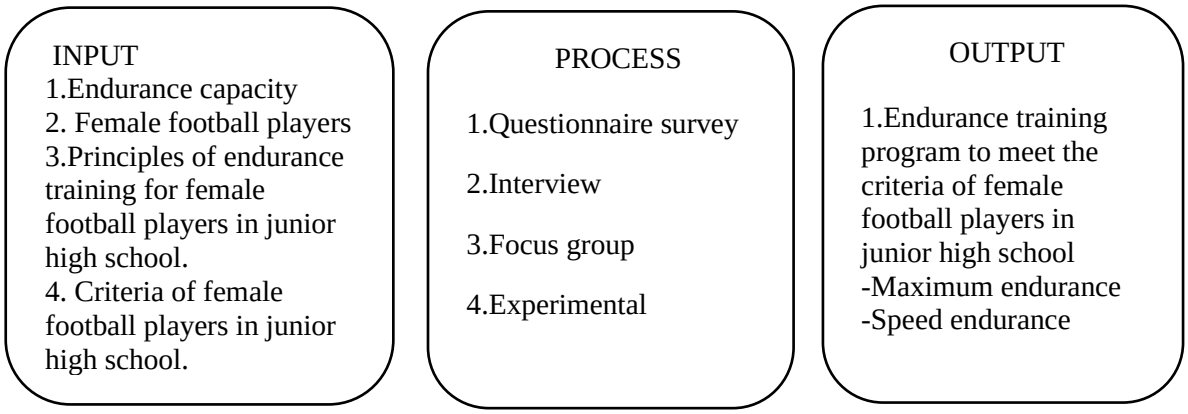

Figure 1 Conceptual Framework

Methodology

Population and sample

1. Population

The population of this study was 45 female football players from the Dongfeng Middle School Football Club in Langzhong City, Sichuan Province.

2. Sample

This study takes junior high school female football players in Langzhong City, Sichuan Province, as the research object, conducts an endurance test on 45 football players, and selects the middle 20 football players as the research samples after excluding the football players with the highest and lowest capacity.

Research participants

The purposive sampling method was adopted to screen according to the following conditions:

1. Three experts for the IOC
2. Five interview experts
3. Ten focus group experts
4. Seven connoisseurship experts

Research instrument

1. Questionnaire for female football players.
2. Interview form
3. Focus group guideline
4. Connoisseurship method
5. Endurance training program
6. Endurance test methods:
7. Endurance criteria for female football players in junior high school. （Liu & Guo, 2014）

Data collection

1. A face-to-face questionnaire survey was conducted on forty-five female football players from Dongfeng Middle School Football Club in Langzhong City, Sichuan Province.

2. Five experts were invited to interview existing endurance training methods, and a systematic training outline was developed based on expert opinions.

3. Ten focus group experts were invited to discuss the science, feasibility, and effectiveness of the training program outline, make adjustments and optimizations, and finally organize and perfect a systematic endurance training program.

4 Seven connoisseurship experts were invited to conduct a content analysis of the training plan, focusing on its practicality and applicability in actual training to ensure its effective implementation in the

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endurance training of female football players in Dongfeng Middle School in Langzhong City, Sichuan Province.

5. Develop an 8-week endurance training program for junior high school female football players in Langzhong City, Sichuan province, with sixty minutes of training three times a week. The results of the stages' pre-test, mid-test post-test were analyzed and compared with the criteria.

6 Maximum endurance was tested through a 12-minute run, and speed endurance was tested through a 10-meter, 30-meter, 60-meter sprint, and 5×25-meter return run.

Data Analysis

1. Questionnaire: The statistical analysis method was used to calculate the students' average scores and criterion deviation. The researchers employed the Likert scale for evaluation, as follows ($\bar{x}$, S.D.) (Zhu,2007):

1 = Very poor ; 2 = Poor ;3 = Moderate ; 4 = High; 5 = Highest

Average score range: Meaning
1.00-1.79 Very Poor
1.80-2.59 Poor
2.60-3.39 Moderate
3.40-4.19 High
4.20-5.00 Highest

2. Content analysis: The results of the discussion were analyzed in terms of expert interviews, focus groups, and the connoisseurship method.

3. Experimental: A one-sample T-test (one-sample) was used for sample analysis, and the data before, during, and after training were compared with the criteria.

Results

Table 1 Summary of Independent Samples T-test for Pre-Experiment and Criteria Maximal Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

Test stage $\bar{x}$ S.D. P
12-minute run (m) Criteria 1956 207 0.67
Pre-Experiment (N = 20) 1937.30 73.53
P > 0.05

Table 2 Summary of Independent Samples T-test for Mid-Experiment and Criteria Maximal Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

Test stage $\bar{x}$ S.D P
12-minute run (m) Criteria 1956 207 0.16
Mid-Experiment (N = 20) 2027.75 133.14
P > 0.05

Table 3 Summary of Independent Samples T-test for Post-Experiment and Criteria Maximal Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

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Test stage	x̄	S.D	P
12-minute run (m) Criteria	1956	207	0.01∗
Post-Experiment (N = 20)	2169.50	305.26	

∗P < 0.05

Table 4 Summary of Independent Samples T-test for Pre-Experiment and Criteria Speed Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

Test stage	x̄	S.D.	P
5×25m Return (s) Criteria	32.79	1.20	0.09
Pre-Experiment (N = 20)	33.41	1.19	
10 m Sprint (s) Criteria	2.16	0.17	0.29
Pre-Experiment (N = 20)	2.28	0.47	
30 m Sprint (s) Criteria	5.17	0.22	0.59
Pre-Experiment (N = 20)	5.21	0.28	
60m Sprint (s) Criteria	9.63	0.59	0.06
Pre-Experimen (N = 20)	9.89	0.30	

P > 0.05

Table 5 Summary of Independent Samples T-Test for Mid-Experiment and Criteria Speed Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

Test stage	x̄	S.D.	P
5×25m Return (s) Criteria	32.79	1.20	0.08
Mid-Experiment (N = 20)	33.41	1.09	
10 m Sprint (s) Criteria	2.16	0.17	0.15
Mid-Experiment (N = 20	2.28	0.33	
30 m Sprint (s) Criteria	5.17	0.22	0.49
Mid-Experiment (N = 20)	5.20	0.01	
60m Sprint (s) Criteria	9.63	0.59	0.05
Mid-Experiment (N = 20)	9.88	0.46	

P > 0.05

Table 6 Summary of Independent Samples T-Test for Mid-Experiment and Criteria Speed Endurance Test Data of Female Football Players at Dongfeng Middle School Football Club, Langzhong City, Sichuan Province.

Test stage	x̄	S.D.	P
5×25m Return (s) Criteria	32.79	1.20	0.08∗
Mid-Experiment (N = 20)	33.41	1.09	
10 m Sprint (s) Criteria	2.16	0.17	0.15∗
Mid-Experiment (N = 20)	2.28	0.33	
30 m Sprint (s) Criteria	5.17	0.22	0.49∗
Mid-Experiment (N = 20)	5.20	0.01	
60m Sprint (s) Criteria	9.63	0.59	0.05∗
Mid-Experiment (N = 20)	9.88	0.46	

∗P < 0.05

According to the research results, the maximum endurance of female football players pre-test is not significant, which is not as good as the criteria; The mid-test results were not significant. The results at the post-test stage of the experiment were significant.

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As for speed endurance, the results in the pre-test stage of the experiment were not significant, the results in the mid-test stage of the experiment were not significant compared with the criteria, and the results in the post-test stage of the experiment were significant. The specific reasons will be described in detail in the discussion section of the next chapter.

Discussion

1. Maximum endurance

The pre-test endurance levels of the experimental group in the 12-minute running test were below the criteria, providing a comparable basis for subsequent training interventions, possibly because the intensity of the previous endurance training program was not developed enough. (Guo, 2017) pointed out that the training intensity should be flexibly adjusted according to the training requirements at different stages, but the quality of the training effect mainly depends on the rationality of the training intensity. The intensity is too low, can not effectively promote the development of respiratory and circulatory system function, and it is difficult to improve aerobic endurance. If the intensity is too high, it will shorten the training time, change the way of energy supply, and affect the training effect. This indicates that there may be some problems in the intensity setting of the training program before the experiment, and the effect of endurance training cannot be fully utilized.

After four weeks of training, the results of the 12-minute running test in the experiment showed little change in performance, indicating that the improvement in endurance at this stage did not reach statistical significance. This may be related to the following factors: In the early stages of training, the body may be in the process of adapting, especially for players who have not done much endurance training, and the first few weeks of training may activate more neurological adaptation than significantly improve aerobic endurance. Four weeks of training is relatively short and may not be enough to cause noticeable physiological changes. (Guo & Li, 2008) pointed out that increasing VO2 Max and lactate threshold usually requires longer training time. Individual differences in participants' adaptation to training may cause some players' endurance levels to improve faster and others more slowly, affecting the overall meaning of the data.

After the end of the 8-week endurance training program, there was a significant difference compared with the criteria, significantly improved endurance, and enhanced cardiorespiratory function (Chen, 2019) pointed out that cardiorespiratory function. As we all know, as an important basis for aerobic endurance, cardiorespiratory function has always been an important indicator. Good cardiopulmonary function is one of the important prerequisites for adequate oxygen supply during exercise. Therefore, the pumping function of the heart and the ventilation function of the lungs are the center of gravity, which affects the oxygen absorption capacity. (Gu, 2015) pointed out that there are many methods of endurance training, and each method has its advantages. At present, the methods of endurance training include: continuous training, interval training, repetitive training, change training, game training, circuit training, altitude training, and so on. If the training program includes interval training (short bursts of high-intensity running), long-distance aerobic running, and strength training, this different approach may contribute to the significant improvement observed after 8 weeks.

2. Speed endurance

In the 5×25m round-trip running experiment, the speed endurance of the subjects before the experiment was lower than the criteria, which may be due to the weak physical foundation and the lack of special endurance training (such as repeated sprint training, variable speed running, etc.), resulting in the speed endurance not meeting the criteria. (Cui etal, 2024) pointed out that the 5×25m running test mainly examines the player's ability to sprint quickly and repeatedly over a short distance, which is reflected in the football game as the player's running performance when making quick offensive and defensive transitions on the field. Therefore, in order to improve the speed endurance of players, special training should be added, focusing on improving coordination, movement efficiency, and leg strength during the entire training period, so as to enhance their ability to sprint short distances and continue high-intensity exercise. At week 4, the test results were not statistically significant compared to the criteria, which may indicate that the amount of training in the first four weeks was small, mainly the acclimation phase, and the physiological changes had not yet accumulated to the point of significant enhancement. (Hu, 2019) points out that the following points should be paid attention to when carrying out activities to improve players' speed endurance: First of all, teachers should formulate scientific and appropriate speed and endurance improvement programs according to the actual situation of players, set targeted load training through

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comprehensive analysis of players' sports performance, personal characteristics and other factors, and appropriately adjust the corresponding training intensity according to the load capacity of players, rather than blindly set the same intensity. Teachers should adopt progressive training methods, appropriately increase the intensity of exercise training, and adopt diversified training methods. After the end of the experiment (week 8), the endurance capacity of the experimental group was significantly improved, and the performance was better than the criteria, and the training adaptation effect gradually appeared. The exercise physiology study showed that the improvement of aerobic endurance and anaerobic endurance was usually more obvious after 6 to 8 weeks, which was in line with the training adaptation curve (Wang & Sun,2023).

In the 10m run test, there was no statistically significant difference between the test results of the subjects before the experiment and the criteria, possibly due to the lack of systematic training, but their short sprint ability remained at a certain level. After 4 weeks of training, the experimental group's performance did not improve significantly compared to the norm, suggesting that strength training for short sprints often takes longer to produce measurable results, which may be related to insufficient training intensity. (Shen, 2018) pointed out that to adapt to the internal environment with high lactate concentration, the training load and intensity should be systematically considered when arranging speed endurance training, so that players can train under the maximum glycolytic state, thereby improving the blood lactate level, promoting the adaptive fatigue of muscle fibers, and ultimately improving speed endurance. After 8 weeks of training, the experimental group's sprint ability improved significantly. The training strengthened the neuromuscular coordination and improved the ability of muscle fiber recruitment. (Li & Pu, 2021) pointed out that to improve the speed and explosive power of players, the use of slope running or low-step training with a slope of 10% to 15% can help enhance the players' explosive power and sprint ability, so that the muscles contract faster and more efficiently during sprinting.

In the 30-meter run test, there was no statistically significant difference in the test results of the subjects before the experiment compared to the criteria, although the endurance training was conducted before, but the cycle was short or insufficient to significantly improve the sprint performance of the 30m run in a short time. After 4 weeks of training, the sprint time of the experimental group did not improve significantly, which may not be enough to produce significant physiological adaptation and technical improvement, especially in the improvement of short explosive power and starting response. After eight weeks, however, sprint times improved significantly. (Liu, 2021) pointed out that in different training stages before, during, and after the experiment, coaches should make personalized training programs according to each player's physical condition and training progress. By analyzing the data collected throughout the training process, the workload and training intensity of each player should be adjusted, rather than applying the same intensity to the entire team. In daily training, a step-by-step approach should be taken to avoid overly aggressive training methods that may backfire. A varied and balanced training program helps players gradually improve their performance. For high-intensity, high-load training, it should be done at most once a week and should not be scheduled before the competition, because excessive fatigue will prevent the player from performing at his best during the competition.

In the 60m run test, there was no statistically significant difference between the pre-test subjects' test results and the norm, possibly because the pre-test training program was not specifically optimized for short bursts and acceleration. (Cometti, 2021) Studies have shown that combining high-load and low-load training can not only improve explosive power, but also enhance explosive power endurance. This training method helps players maintain explosive power during high-intensity exercise by performing fast movements while fatigued. After 4 weeks of training, sprint time in the experimental group did not improve significantly, possibly due to the shorter training cycle. (Chen, 2023) Some studies have pointed out that after 4-5 weeks of intense training, players' performance usually reaches a plateau, at which point the training intensity or cycle needs to be adjusted to maintain progress. After 8 weeks of training, the sprint time of the experimental group has been significantly improved, which indicates that with the deepening of training, the training intensity of the experimental group has gradually increased, and the training content has gradually increased the load, which effectively improves the maximum output capacity and endurance level of the players. (Cui etal, 2024) pointed out that increasing the intensity of training can improve endurance. For example, by multiple short sprints, players can quickly expend energy in a short period of time and recover quickly during intervals, thus reducing the accumulation of fatigue. Interval training allows players to continue training even when they are not fully recovered, thereby further improving the body's adaptability and endurance level.

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Conclusion

This study aimed to develop an endurance training plan to improve the endurance ability of junior high school female football players. With the promotion of national policies, football activities have become an important part of youth sports activities, focusing on how to encourage young people to participate in football, improve the level of physical fitness, and apply scientific physical training methods.

This study comprehensively analyzed the endurance training of junior high school female football players through a variety of methods, including IOC validity assessment of questionnaire design, expert interviews, focus group discussions, and expert appraisal, to ensure the scientific and practical research. Firstly, experts in the field of physical education and training were invited to evaluate the validity of the questionnaire to ensure the rationality of the measurement indicators. Then, professional opinions on endurance training were collected through expert interviews, and combined with focus group discussions, training methods, effect evaluation, and optimization strategies were discussed in depth. Finally, experts were used to evaluate the quality of the questionnaire to improve the reliability and applicability of the research tool, and finally, to provide scientific guidance and practical support for the endurance training of junior high school female football players. After the training program is worked out, the players are trained for 8 weeks. In the fourth week, a test is conducted on the players, and it is found that some items are not significant because the training time is not long enough. Finally, after 8 weeks of training, the results after the test are more significant than those before training.

After the maximum endurance test, the 12-minute run result showed $p = 0.01$ ($p < 0.05$), indicating that the endurance capacity of junior high school female football players after training was significantly improved compared with the criteria, which verified the effectiveness of the training program. In the speed endurance test, the 10m sprint $p = 0.00$, the 30m sprint $p = 0.00$, the 60m sprint $p = 0.01$, and the 5× 25m return $p = 0.02$ ($p < 0.05$), indicating that there were significant statistical differences in the test results. This shows that the endurance training program can effectively improve the physical fitness level of players, lay a foundation for long-term endurance training and sports achievements in the future, and has important practical significance for optimizing endurance training methods.

Recommendation

1. The endurance training program of junior high school female football players should be combined with cross-training methods
2. The endurance training program for junior high school female football players should be taught according to their aptitude.
3. To improve the overall development of endurance quality and capacity of junior high school female football players at all stages

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