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The Effect Of HIIT Exercises On Speed-Strength And Some Physiological And Skill Variables In Handball Players

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Abstract

This paper examines the impacts of high-intensity interval training (HIIT) on speed-strength and a variety of physiological and skill-based variables in handball players. The main objective is to determine the effectiveness of this modality of training to enhance the performance measures that are directly applicable to the sport and give empirical data that may guide coaches and experts in the development of more effective and sport-specific training programs. The research question will be in the following form: What would be the effect of high-intensity interval training (HIIT) on improving speed-strength and other physiological and skill-related parameters in handball players? The study objectives were to construct HIIT exercises that were specifically aimed at enhancing the speed -strength and other physiological and skills-based traits relevant to handball. The general objective was to determine the impact of HIIT on these parameters. A quantitative experimental research design was selected, which included an experimental group, and a control group which was considered the best way of tackling the research problem. The sample was comprised of 16 participants who were members of the handball team of Maysan Education Directorate. The total population was divided into a random sample of 12 players, six players were selected in each study group; experimental and control group. Two players were also not included in the study due to being goalkeepers and two other players were dropped out of the experimental group. Statistical tests were done by means of SPSS 26. The results show that the applied HIIT programmed improved the speed-strength of the participants that signifies increased efficiency of the fast-twitch muscle fibers. In addition, the training intervention programs produced a tremendous gain in maximal aerobic capacity (VO_2 MAX), thus enhancing the athletes to maintain intense and repetitive workload in the competition. The recommendations of these results are that HIIT should be included in the physical preparation programs of handball practitioners, and a keen focus on increment of levels of intensity and duration is required to suit the requirements of the sport. Slow progression of this nature is necessary to ensure physiological adaptation with minimal risk of fatigue or injury.

Keywords: High-Intensity, Interval Training Exercises, Speed-Strength, Physiological Variables, Skill Variables.

Introduction

The sports sphere training process has also undergone significant transformation because of the growing dependence on modern scientific bases, which strive to raise the standards of physical, physiological, and skillful performance of athletes, in particular, in team sports with various needs and different types of efforts imposed in the game. It is believed that the growth of physical and physiological capabilities is among the cornerstones to achieving an exemplary competitor performance, as it has a direct impact on enhancing the effectiveness of implementing motor skills and preserving the performance levels during the time of the match. Handball is regarded as being among the fast-paced group games, which is dependent on high-intensity intermittent output. To achieve high success in this sport, players must have certain physical skills, the first of which is speed-strength, and high physiological efficiency that would help to repeat the application of skills successfully at all stages of the game. The peculiarities of the game also presuppose the ability of the players to switch between the offensive and the defensive in a short period of time, and therefore the creation of the physical and physiological side is one of the most important aspects of competitive advantage.

High and Intensity Interval Training (HIIT) is regarded as one of the contemporary training strategies that have highly conformed to the performance demands in team sports since it is based on the repeated physical activity with high loads interrupted by brief constraints. This mode of training also helps to elicit the creation of favorable physiological adjustments in the physiological systems that are involved, not only does it help in the development of particular physical skills especially speed-strength that is a key component in carrying out high-efficiency skill performance in handball.

The technical skills in handball are highly essential since jumping shots are one of the most notable offensive skills in handball that needs a combination of physical, physiological, and technical skills, particularly when they are performed under the circumstances of physical fatigue during the game. It is through this that any growth either physically and physiologically, is likely to be reflected positively on the accuracy and effectiveness of the skill performance in case of a competition. The significance of the study is the investigation of the effect of the high-intensity interval training (HIIT) on speed-strength and certain physiological and skill-related parameters in handball players. The purpose of it is to evaluate the success of this training approach in enhancing the performance goals that are peculiar to the game, and to offer scientific indices to help instruct coaches and other experts to adopt more effective training programs that are applicable to the nature of handball.

1.2 Research Problem

Thru the researcher's observation of the reality of the training process in handball, and given his background as a former player, as well as his field monitoring of the clubs' work in Maysan Governorate, he noticed that most training programs rely on traditional methods in physical preparation, with little use of modern training techniques that align with the nature of the high-intensity intermittent performance required by the game's demands. This has been reflected in the variation in levels of speed-strength and

physiological efficiency among the players, which in turn affects their ability to maintain the quality of skillful performance, particularly the jump shot, during different periods of the match. Based on these field observations, the research problem is defined by the following question:

To what extent do high-intensity interval training (HIIT) exercises contribute to the development of speed-strength and some physiological and skill variables among handball players?

1.3 Research Objectives

1. Preparing (HIIT) exercises to develop speed-strength and some physiological and skill variables for handball players. Preparing (HIIT) exercises to develop speed-strength and some physiological and skill variables for handball players.
2. Recognizing the impact of (HIIT) exercises on developing speed-strength and some physiological and skill variables for handball players. Identifying the impact of (HIIT) exercises on developing speed-strength and some physiological and skill-related variables in handball players.

1.4 Research Hypotheses

- There was statistically significant difference between the pre-test and the post-test score of both experimental and control groups thus supporting the post-test results. Significant difference was also observed statistically between the pre-test and post-test results of both groups with the latter being preferred.
- The post-tests of the experimental and control groups showed statistically significant differences, with the former one showing higher results. The post-tests of the control and experimental groups proved the presence of statistically significant differences with the results in the experimental group having better results.

1.5 Research Fields

1.5.1 Human Field: Players of the Maysan Education Team
1.5.2 Spatial domain: Martyr Saad Khalaf Subuf Hall.
1.5.3 Temporal scope: from 6/9/2025 to 9/11/2025.

2. Methodology

The process of experimentation is regarded as one of the most prevalent approaches in sports education research due to its foundation on two essential principles: observation and experimentation (Abd 2019, 81). Consequently, the researcher employed the experimental method utilizing a design comprising two equivalent groups, experimental and control, owing to its appropriateness for the research problem.

2.2 Research Population and Sample

This study's sample comprised 16 players from the Maysan Education Handball Team for the 2024-2025 season. The research sample comprised 12 players, removing two players for the exploratory trial and two goalkeepers. They were allocated by lottery into two groups: a control group and an experimental group, each comprising 6 players. To guarantee the uniformity of the research sample participants, the skewness coefficient was employed to analyze the variables of height, weight, chronological age, and training age, as illustrated in Table (1).

Table 1: It shows the homogeneity of the research sample

Variables	Measurement unit	Mean	Median	St.d	
Height	cm	174.4	175	2.27	
Weight	kg	72.7	72	2.90	
Training age	year	3.4	3	0.51	
Chronological age	year	18.3	18	1.59	

2.3 The means, devices, and tools used

- (Interview, observation, questionnaire, test).
- Performance evaluation forms.
- Laptop computer type (DELL).
- Canon 2900 laser printer.
- One timer clock of SONY brand.
- Whistle.
- Measuring tape.
- Planning tape, 5 cm wide.
- Plastic cones (20 pieces).
- Chinese-made treadmill.
- Fit mate Pro device, made in China.
- Indoor soccer field.
- Handballs (10).
- Mobile camera type IPHONE 14 PRO MAX.

2.4 Field research procedures

2.4.1 Identification of physiological and skill variables

The researcher decided to study one of the physiological variables, which is the maximum oxygen consumption (VO_2 MAX), while for the skill variables, the researcher chose jumping accuracy.

2.4.2 The tests used

A. Test of strength characterized by speed (Abdazid et al. 2021, 183).

The purpose of the test: To measure the explosive strength of the legs.

Necessary tools: Whistle, start line and finish line with a distance of 18 meters between them, measuring tape, stopwatch.

Performance description: The tester stands at the starting line, and upon hearing the whistle, they start by hopping on the left leg and returning on the right leg, recording the time in seconds.
Recording: Each tester has one attempt, and the tester records the time it took to complete the distance in seconds.

B. Maximum Oxygen Consumption Test (VO_2 MAX) (Hassan 2021, 47-48).

The purpose of the test: To measure the maximum oxygen consumption, VO_2 MAX.
Devices and tools: Fit mate Pro device using the treadmill (Trad Mill).
Performance description: The player's data is entered as required in the Fit Mate Pro device.
The (Fit mate pro) then select the VO_2 MAX test.

1. The tester performs a warm-up on the treadmill by controlling the speed for 3-5 minutes before conducting the actual test. The tester performs a warm-up on the treadmill by controlling the speed for a duration of 3-5 minutes before conducting the actual test.
2. The tester steps onto the treadmill, then wears the heart rate monitor belt and the VO_2 MAX indicator mask for the Fit Mate Pro device. The subject steps onto the treadmill, then wears the heart rate monitor belt and the VO_2 MAX indicator mask for the Fitmate Pro device.
3. The treadmill is turned on, and then the Fit Mate Pro device, which has been previously set to the VO_2 MAX test, is turned on. The treadmill is turned on, followed by the Fit Mate Pro device, which has been previously set to the VO_2 MAX test.
4. Here, the Bruce protocol for graded exercise begins, where the tester increases the speed and incline of the treadmill every three minutes and increases the intensity every three minutes according to the Bruce test protocol. The subject continues to perform until exhaustion and then presses the stop button on the treadmill. Here begins the Bruce method for performing the graded exercise, where the test administrator increases the speed and incline of the treadmill every three minutes and increases the intensity every three minutes according to the Bruce exercise test schedule. The subject continues to perform until exhaustion and then presses the stop button on the treadmill.

Score calculation: The result is based on the value of (VO_2 MAX) provided by the device, measured in milliliters/kilogram/minute.

Stage	Speed (km/hr)	Speed (mph)	Gradient
1	2.74	1.7	10
2	4.02	2.5	12
3	5.47	3.4	14
4	6.76	4.2	16
5	8.05	5.0	18
6	8.85	5.5	20
7	9.65	6.0	22
8	10.46	6.5	24
9	11.26	7.0	26
10	12.07	7.5	28

Figure 1: Shows the protocol for the Bruce test

C. Jump Shot Test in Handball (Karim 2023, 63-64)

The purpose of the test: Measuring the accuracy of forward jump shooting.

Equipment: Ten handballs and a handball goal depicted on an indoor wall, with five circles with a diameter of 60 cm; four circles are positioned at each corner, while the fifth is centered below the crossbar.

The tester positions themselves behind the 7m line and executes ten shots into the designated circles on the goal. This is accomplished after taking three steps, followed by a jump and then a throw. The sequence begins with the upper right circle, followed by the upper left, the center, the lower right and concludes with the lower left circle.

Conditions:

1. Each participant receives 10 attempts to place the ball inside the circles, with 2 balls allocated for each circle, acknowledging that each circle possesses a designated test value. Each player is allotted 10 attempts to place the ball into the circles, with two balls designated for each circle, each possessing a certain test value.
2. Two attempts are permitted prior to the commencement of the test. Two attempts are permitted prior to the commencement of the test.
3. The shot must be executed after taking three steps and then jumping; touching or crossing the firing line, which is 7 meters from the throw, is prohibited. The shot must be executed after three steps and a jump, and touching or crossing the firing line, located 7 meters away, is prohibited prior to the throw.

Scoring: The evaluator allocates two points for each ball that enters the upper right and left corners, one point for each ball that enters the middle circle, and three points for the lower right and left circles. The test score varies from 0 to 22 points.

2.4.3 The Pilot Study

"The exploratory experiment is considered one of the most important and necessary procedures to identify the precise scientific weight of the tests proposed for work and to avoid the errors and obstacles that the researcher may face when conducting the main

experiment" (Majid 2022, 545). Consequently, the researcher executed an exploratory experiment on Saturday, June 9, 2025, with participants from the researcher's community outside the sample, at the hall of Martyr Saad Khalaf Sweif, prior to conducting the main research to determine appropriate procedures and tools.

2.4.4 Pre-tests

The researcher and the aiding team conducted pre-tests before to initiating the training program. The tests encompassed the three variables under examination precisely at four o'clock in the afternoon on Thursday, November 9, 2025, in the Martyr Saad Khalaf Swaif Hall. The equivalency was derived by the tests presented in Table (2).

Table 2: It shows the equivalence of the research groups

Tests	Unit measurement	Experimental group		Control group		t. test	Sig	Significance
		Mean	St.d	Mean	St.d			
The force distinguished by speed	Second	13.27	1.41	12.86	0.93	0.58	0.57	Insig
VO_2 MAX	Ml/kg/min	37.35	1.46	37.14	1.22	0.26	0.79	Insig
Jump shooting	degree	11.16	2.31	10.66	2.53	0.35	0.72	Insig

• Not significant at the 0.05 significance level with 10 degrees of freedom.

2.4.5 The main experiment

Following the completion of the pre-tests, the exercises were executed only for the experimental group during the training sessions, specifically from Sunday, September 14, 2025, to Thursday, January 6, 2025, in the hall of martyr Saad Khalaf Sweif. After reviewing the sources, references, and literature on sports training, the exercises were designed and incorporated into the training units and the main part with the aim of studying the effect of high-intensity interval training (HIIT) exercises on developing speed-strength and some physiological and skill variables under study among the experimental group members. Three training units were conducted weekly on Sundays, Tuesdays, and Thursdays, allowing for a balanced distribution of effort with sufficient recovery periods. The exercises were designed and included in the main part, taking into account the weekly time progression. The designated exercises were implemented at the commencement of the primary segment of the training unit, with the intensity of the exercises contingent upon the training unit's intensity established by the team coach, varying from 85% to 95% of the maximum heart rate. The HIIT exercises included physical and physical-skill elements specific to handball, such as consecutive vertical jumps with shooting, quick zigzag running with passing and receiving, squat jumps and forward lunges, and short sprints with shooting. The exercises were designed

progressively, with the work duration increasing in each unit weekly, while maintaining the required high training intensity to ensure the development of speed-strength and achieve positive physiological adaptations, along with enhancing the players' skill performance, particularly in the jumping shooting skill. This program is suitable for the research sample, as it combines physical and skill training in a practical context that aligns with the high-intensity intermittent performance required in handball matches. With a focus on performing at maximum speed during work periods, the quantity of training units attained was 24. The duration of these activities fluctuated weekly, progressively increasing from the second to the eighth week, culminating in a total exercise time of 492 minutes for the eight-week period. Table 3 illustrates this.

Table 3: displays the duration of exercises inside a single training session, over the course of one week, as well as the cumulative time of activities across eight weeks

Weeks / **Times**	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**For the targeted workouts that take place**
The duration of exercises in a single training unit	10 min	13 min	16 min	19 min	22 min	25 min	28 min	31 min	-------
The duration allocated for exercises throughout a week	30 min	39 min	48 min	57 min	66 min	75 min	84 min	93 min	492 min

2.4.6 Post-tests

After the entire experiment concluded and lasted eight weeks, the researcher conducted post-tests to experimental and control groups on Sunday, November 9, 2025. He used the same procedures applied in the pre-tests and ensured that all the temporal, spatial and instrumental conditions aligned with the pre-tests was observed during the post-tests thus protecting the validity of the result.

2.5 Statistical Methods

The researcher utilized the statistical software (SPSS 26) to obtain the subsequent values:

The mean, standard deviation, median, skewness, independent samples t-test, one-sample t-test, mean differences, standard error, degrees of freedom, and significance level.

3. Presentation, analysis, and discussion of the results

3.1 Presentation of the pre-test and post-test results for the experimental group

Table 4: presents the outcomes of the pre-test and post-test for the experimental group.

Tests	Unit measurement	Prior		Subsequent		t. test	Sig	Significance
		Mean	St.d	Mean	St.d			
The force distinguished by speed	**Second**	13.27	1.41	9.45	0.85	7.90	0.001	**Sig**
VO_2 MAX	**Ml/kg/min**	37.35	1.46	42.65	0.76	7.71	0.001	**Sig**
Jump shooting	**Degree**	11.16	2.31	17.15	0.75	5.33	0.003	**Sig**

- Significant at a significance level of (0.05) and degrees of freedom (5).

Table 4 unequivocally shows statistically significant differences between the pre-test and the post-test of the experimental group where post-test results were better compared to the pre-test in the speed-strength test. The mean of the pre-test was 13.27s (SD 1.41), and the mean of the post-test was 9.45s (SD 0.85). The t-test gave the calculated t-value of 7.90 that is significant at the level of 0.001 as compared to the traditional significance of 0.05 and five degrees of freedom that is less than 0.05. This means that the differences were huge and favorable to the post-test of the experimental group.

Depending on the results of a VO 2 -max test, significant statistical differences between the pre-test results and the post-test results are observed in the experimental group, with the post-test results being more favorable. Pre-test mean was 37.35mL kg/min -1 (SD = 2.31), and the post-test mean was 42.65mL kg/min -1 (SD = 0.76). A t-test generated a calculated t-value of 7.71 that is significant at the 0.001 level and when compared to the 0.05 significance level with five degrees of freedom, which is less than 0.05. The differences are therefore large and favorable to the post-test group.

The jump-accuracy test provides statistically significant differences of pre-test scores versus post-test scores, where post-test scores are better than pre-test scores. The popular mean score of the pre-test (SD= 2.31) was 11.16 and the posttest (SD= 0.75) was 17.15. The t-test produced a calculated t-value of 5.33 that is important at the level of 0.003 compared to the level of significance of 0.05 with five degrees of freedom that also falls short of 0.05. In this way, the differences that are observed are large and in support of the post-test performance.

3.2 Presentation of the pre-test and post-test results for the control group

Table 5: It shows the results of the pre-test and post-test for the control group

Tests	Unit measurement	Prior		Subsequent		t. test	Sig	Significance
		Mean	St.d	Mean	St.d			
The force distinguished by speed	**Second**	12.86	0.93	11.29	0.70	5.03	0.004	**Sig**
VO_2 MAX	**Ml/kg/min**	37.14	1.22	40.19	0.57	5.72	0.002	**Sig**

Jump shooting	**Degree**	10.66	2.53	14.83	0.83	4.11	0.009	**Sig**

- Significant at the significance level (0.05) and degrees of freedom (5).

Table 5 shows statistically significant values between the pre- and post-test in the control group, wherein the post-test shows better results in the speed-strength test. The mean of the pre-test was 12.86s (SD 0.93), and the post-test was 11.29s (SD 0.70). Two sample t -test: $t(5) = 5.03$, $p < 0.005$; the significance level of 0.05 was significantly exceeded, which means that the differences were not only significant but also in favor of the post-test.

The VO_2 max test shows statistically significant differences between pre and post-test values in case of the control group where post variables give better results. The mean of the pre-test was 37.14ml kg/min -1 (SD1.22), whereas the mean of the post-test was 40.19ml kg/min -1 (SD0.57). The t-test two sample has calculated $t (5) = 5.72$, $p = <.003$, much less than the traditional 0.05 = 0.05, which has proven significant and beneficial changes to the post-test among the control group.

In the jump-accuracy test, significant differences between pre- and post-test measurements were statistically recorded as well as the post-test scores are more positive in the control group. The mean score was 10.66 0 (SD=2.53) based on the pre-test, and 14.83 0 (SD=0.83) based on the post-test. The two-sample t -test provided a $t(5) = 4.11$, $p = 0.010$, which shows that the results are significant and positive due to the post-test results in the control group.

3.3 Presentation of the post-test results for the experimental and control groups

Table 6: It shows the results of the post-tests for the experimental and control groups

Tests	**Unit measurement**					**t. test**	**Sig**	**Significance**
		Mean	**St.d**	**Mean**	**St.d**			
The force distinguished by speed	**second**	9.45	0.85	11.29	0.70	4.07	0.002	**Sig**
VO_2 MAX	**Ml/kg/min**	42.65	0.76	40.19	0.57	6.84	0.000	**Sig**
Jump shooting	**degree**	17.15	0.75	14.83	0.83	5.36	0.000	**Sig**

- Significant at the significance level (0.05) and degrees of freedom (10).

Table (6) shows statistically significant differences in the results of the post-test of the experimental and control group, with the experimental group showing higher results in speed-strength test. The post-test mean of the experimental group was 9.45 seconds and the standard deviation was 0.85 and the post-test mean of the control group was 11.29 seconds with a standard deviation of 0.70. The t -test statistical test gave a calculated t -value of 4.07, significant at the level of 0.002, less than the significance level of 0.05, and

degrees of freedom of 10. This implies that the differences that were realized were large and favorable to the experimental group.

The VO_2 MAX test showed significant statistical differences between pre-test of the experimental and control groups, which were in favor of the post-test of the experimental group. The experimental group had a mean of 42.65 mlkg-1min -1 with the standard deviation of 0.76 as their post-test mean and the standard deviation of the control group had 40.19 mlkg-1min -1. On statistical analysis, t -test, the calculated t -value was found as 6.84 significant at the level of 0.000, not 0.05 as the significance level is 0.05, and the degrees of freedom are 10, which is not 10. It means that the experimental differences were great and beneficial to the experimental group.
The statistically significant differences in the results of the jump accuracy test are observed between the pre-test outcomes of both experimental and control groups with the post-test outcomes of the experimental group indicating good results. The mean score of the experimental group was 17.15 degrees and the standard deviation of 0.75, and that of the control group is 14.83 degrees with the standard deviation of 0.83 in the post-test. The t-test statistical test gave the comparison of calculated t-value of 5.36 which is significant because the level of significance of the test was 0.000, which is less than 0.05, but there was a degree of freedom of 10. This shows that the differences were high and favorable to the experimental group.

3.4 Discussion of the Results

Judging by the findings displayed in the Tables (4, 5, 6), it can be stated that there has been a major improvement which can be attributed to the application the high-intensity interval training (HIIT) exercises which are structured by the researcher. Such improvement is expressed as a statistically significant and evident increase in the three variables that are studied, speed -strength, maximum oxygen consumption (VO_2 MAX) and jumping shooting skill, among handball players in the experimental group compared to the control group. The results, therefore, highlight the usefulness of this training procedure in promoting holistic growth at the physical, physiological, and skill performance levels. The improved results may be explained by the peculiarities of physiological and training conditions that HIIT provokes and cause extensive adaptive changes in the muscular, cardiovascular, and respiratory systems. These modifications are also in line with performance requirements of intermittent-effort sports like handball. In the speed strength variable, where the high force production requires delivery in a temporally limited period, HIIT is especially effective since it forces the neuromuscular system to work at its utmost effort in a series of short intervals separated by short rest periods. This repetitive stimulus increases the muscle fibers of the fast-twitch type ability to generate force faster and more precisely (Buchheit and Laursen 2013, 315). The fact that the researcher has stated in the research that the speed-strength metric of both the experimental group and the control group have statistically significant differences, also seems to be in line with this mechanistic explanation. In the case of VO_2 MAX, its importance lies in the fact that this is one of the main physiological parameters that determine the ability of the body to use oxygen during the effort. The statistics show that there is a significant change in favor of the chemical group, which points out that the HIIT program has brought positive changes in the cardiorespiratory system. Some of

these adaptations comprise an augmentation in the quantity of the stroke volume, augmented activity in the mitochondrion of the muscle fibres together with an augmentation in the efficiency of oxygen delivery to the active tissues, which effectively raises VO_2 MAX compared to the traditional aerobic training with the same duration (Laursen and Jenkins 2002, 57). This is the result that supports the opinion that HIIT is one of the most effective ways of increasing maximal aerobic capacity (Helgerud et al. 2007, 665). With regard to the skill variable of jump shooting, the training intervention produced a significant difference in favor of the experimental group. The latter can be explained by the fact that the physiological and muscular benefits of HIIT are closely related, and the game-specific skills are performed competently. Jump shooting in handball presupposes the combination of explosive, fine motor timing, and partial endurance of muscles, which is developed in the course of high-intensity interval training with repetitive stressing of the muscular system under fatigue conditions, which increases the capacity of the athlete to maintain the quality of the skill in the successive efforts. This form of training is also not only more effective in building up muscle power, but also neuromuscular coordination and motor accuracy, which are transferred to more complicated skills like jumping shots (Michalsik et al. 2013, 218). These theoretical considerations are therefore consistent with the significant improvement that was seen in the experimental cohort.

4. Conclusions and Recommendations

4.1 Conclusions

- The training (high-intensity interval training) methods developed by the researcher were discovered to improve the speed-strength of handball players, which is a pointer of the efficiency of fast-twitch muscle fibers.
- The high-intensity interval training (HIIT) protocols that the researcher created proved to be efficient in increasing the speed-strength of handball athletes, which is in part a sign of efficient work of the fast-twitch muscle fibres.
- The structured activities created a significant change in the maximum aerobic capacity (VO2 max) that improved the capacity of the athletes to perform strenuous and repeated activities in competitive play.
- The structured workouts delivered a significant change in maximal aerobic capacity (VO 2 max), thus increasing the capacity to maintain vigorous and repeated working at the time of playing competitions in the athletes.
- The training helped to meet the improvement of the implementation of the jumping shot, thus providing an example of the union of physiological and biomechanical improvement with technical performance.
- The training enabled the enhancement of the performance of performing jumping shot, which then demonstrates the combination of physiological and biomechanical performances with technical performance.
- The outcomes were that planning HIIT interventions in harmony with the particular demands of the handball results in the overall growth of the players, including physical, physiological, and skill-related capabilities.

- These findings showed that the development of HIIT interventions based on the particular needs of handball conducts to a holistic development of the players including the physical, physiological, and skill-related capacities.

4.2 Recommendations

- The physical preparation programmers of the handball athletes should be combined with high-intensity interval training where focus should be on the intensity gradients and time intervals which are in line with the sport requirements. The inclusion of the HIIT exercises in the conditioning programs of the handball players, through progressive increments in terms of magnitude and duration, is the most important in bring physiological load to the nature of the game.
- The increment in intensity and the period of trainings must be introduced in a slow pace to accommodate adaptations and to avoid the danger of psychosomatic stress or musculoskeletal damage. A progressive intensity gradient and a long period of training unit are necessary requirements to ensure the induction of adaptation and minimize the risk of having adverse events.
- Game-specific skills should be combined with physical exercises to ensure that the improvement of physical and physiological arenas is reflected in the improvement of performance in the skills. The proposed integration of conditioning exercises with sport-specific technical activities is a strategy that will guarantee that the strength, power, and endurance gains are reflected in the on-court ability.
- Similar research ought to be conducted on other groups to ensure that the generalizability of such studies. Parallel studies of the various samples are required to support the validity of the suggested training plans outside the first group.

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