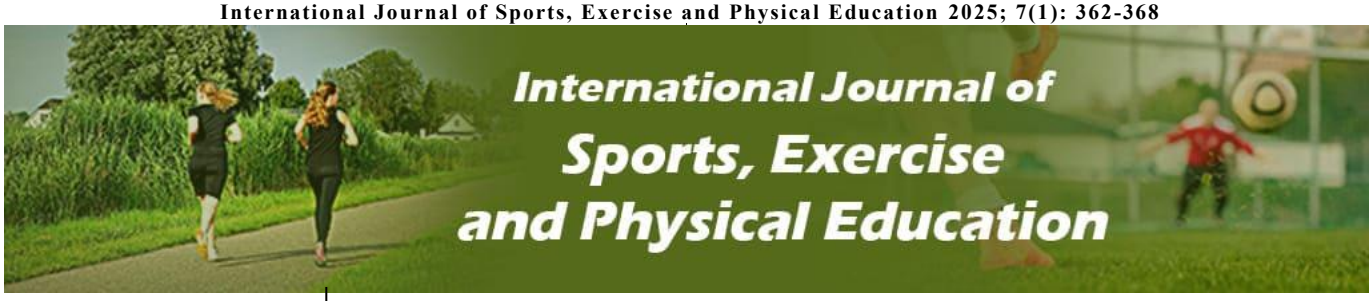

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The effect of compound exercises (Physical, Physiological) supported by polar m430 devices on developing explosive power in futsal players

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Abstract
The purpose of this paper is to preparing complex exercises (physical, physiological) using the Polar m430 to develop the explosive power of players from the Karkh II Education Team, preparatory stage, futsal team in Baghdad, exploring the effect of complex exercises (physical, physiological) using the Polar m430 to develop the explosive power of players from the Karkh II Education Team, preparatory stage, futsal team in Baghdad, and exploring the effect of iron supplementation (hemoglobin) on the biochemical research variable. The study was conducted using the experimental approach by the researchers. The research population consisted of (12) players from the Karkh II Intermediate School Futsal Team, out of (72) players, after subtracting goalkeepers and injured players. The total number of players was (8). This indicates that the proportion of the research population to the original population was (9%). Two groups were randomly selected a control group and an experimental group—using a randomized method. The first experimental group was given the curriculum and nutritional supplements, while the second group was subjected to the training curriculum only. The remaining participants were divided. (4) players were assigned to the experimental group and (4) players to the control group. One of the most important results reached by the researcher is that: Compound exercises (physiological and physical) based on Polar m430 readings for the experimental group had a significant impact on improving the physical component (explosive power), and it is essential that each player use a Polar m430 dedicated to them in order to develop explosive power. One of the most important recommendations recommended by the researchers is that: Emphasize the need to use monitoring devices to improve other physical aspects of their training, and select other nutritional supplements to work with physical and skill capabilities and determine the extent to which these are affected by the supplements used.

Keywords: Futsal, explosive power, sports technology, Polar M430, hemoglobin

Introduction
In recent years, the world has witnessed a rapid and remarkable development in the level of athletic performance across various sports in general, and futsal in particular. This development was not a coincidence, but rather a result of the advancement of various sports sciences, such as sports training, sports physiology, nutrition, functional anatomy, and other related sciences. These sciences have become essential for understanding and improving athletic performance of various types, especially in team events that require high physical effort and precise tactical skills. This necessitates equipping athletes with high and comparable capabilities.

Hence, the importance of utilizing modern scientific and technological methods emerges. These methods play a pivotal role when combined with field experience to support the training process. This integration directly contributes to achieving convergence in performance and continuous progress, leading to the achievement of the desired goals planned by the coaching staff.

Successful training depends on developing physical fitness by developing basic abilities such as explosive Power. Nutritional supplements, which support the health of muscles and bones responsible for movement and performance, are also important factors in helping athletes exert effort for longer periods. From this perspective, the training curriculum plays a key role

in achieving functional adaptation of athletes' physical systems, enhancing their capabilities and improving their performance.

Research Importance

The importance of the current research lies in developing the performance of futsal players through the use of a well-thought-out and integrated training curriculum that includes specific doses of essential iron. The research aims to study the impact of this curriculum on biochemical changes in players and provide results that contribute to enriching the scientific knowledge of coaches, players, academics, and experienced professionals, thus contributing to raising the level of school sports in Iraq.

Research Problem

Futsal has witnessed rapid and noticeable development, particularly in the speed of play and its impact on the physical aspects of players. This development has prompted researchers and specialists in this field to search for the best methods and techniques that contribute to improving the level of athletic performance. Despite the efforts made to design training curricula and provide supportive tools, challenges still exist that affect players' abilities. These include physical weakness, decreased muscle efficiency, signs of thinness and pallor, and a lack of energy. These factors reduce players' ability to maintain physical performance until the end of the match, thus negatively impacting the achievement of desired results.

Through the researchers' observation of futsal players, it became clear that there is an urgent need to improve their overall physical condition and athletic performance. Consequently, it became necessary to explore the effect of using specific doses of iron as part of the training curriculum. These supplements are essential for providing the body with energy and improving physical capacity, especially explosive power, which is a critical component of futsal.

The research problem lies in the need to regulate the use of these nutritional supplements within an integrated training framework that is commensurate with the volume and intensity of training, thus contributing to improving the biochemical variables and physical abilities of the players of the Karkh II Education Team in the preparatory stage. Through this, the research seeks to provide effective solutions that contribute to raising the level of physical and athletic performance, thus achieving the desired ambitions of coaches and administrators and contributing to the development of school sports in Iraq.

Research objective

- Preparing complex exercises (physical, physiological) using the Polar m430 to develop the explosive power of players from the Karkh II Education Team, preparatory stage, futsal team in Baghdad.
- Exploring the effect of complex exercises (physical, physiological) using the Polar m430 to develop the explosive power of players from the Karkh II Education Team, preparatory stage, futsal team in Baghdad.
- Exploring the effect of iron supplementation (hemoglobin) on the biochemical research variable.

Research fields

- **Human field:** Karkh Second Education Team, preparatory stage, futsal team in Baghdad.
- **Time field:** (10/10/2024) to (10/12/2024)
- **Spatial field:** Karkh Second Education Team Stadium in Al-Bayaa, Baghdad.

Terminology

Polar m430: A multi-functional sports watch equipped with advanced technologies for monitoring physical performance and fitness. Equipped with GPS and a wrist-based heart rate sensor, it is designed to meet the needs of runners and athletes seeking to accurately monitor their performance and analyze exercise and training data. It includes numerous features, including wrist-based heart rate monitoring, without the need for an additional chest strap. It provides accurate tracking of distance, speed, and direction while running or exercising outdoors. It also tracks daily activity, measuring steps, calories burned, and periods of activity and inactivity throughout the day. It also enables monitoring of sleep quality and duration through the Polar Sleep Plus feature, which helps improve athlete recovery, as explained in Appendix (2).

First: Research methodology, research community and sample:

The study was conducted using the experimental approach by the researchers. The research population consisted of (12) players from the Karkh II Intermediate School Futsal Team, out of (72) players, after subtracting goalkeepers and injured players. The total number of players was (8). This indicates that the proportion of the research population to the original population was (9%). Two groups were randomly selected a control group and an experimental group—using a randomized method. The first experimental group was given the curriculum and nutritional supplements, while the second group was subjected to the training curriculum only. The remaining participants were divided. (4) players were assigned to the experimental group and (4) players to the control group. The two groups were verified to be equivalent, as shown in Table (1).

Table 1: Shows the equivalence of the members of the two groups (control and experimental) in the pre-test of the explosive Power index.

Variable	Unit of measurement	Experimental group		Control group		T value calculated	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Explosive Power Test	cm	260.37	15.682	256.125	13.329	0.7381	0.4781	Non sig
Hemoglobin	mg	11.562	0.552	11.550	0.292	0.057	0.956	Non sig

Second: Research Test

Hemoglobin Measurement in Blood

- Purpose of the measurement: To determine the percentage of hemoglobin in the blood.

- Equipment Used:

a) A compression belt to be applied to the upper arm.
b) Medical cotton and sterile materials.
c) A medical syringe.
d) Blood storage tubes free of the anticoagulant EDTA.
e) A manual pipette to draw serum from the blood.
f) A centrifuge to separate blood components.
g) Specialized blood collection trays for collecting blood samples.
h) A specialized laboratory staff.

- **Laboratory Procedures**

a) The blood collection process was performed in the medical laboratory by the medical assistant team using sterile tools prepared for this purpose. After collecting the samples, they were subjected to laboratory processing using a centrifuge to separate the serum from the remaining blood components. The samples were then placed in trays designated for hemoglobin analysis. At the end of the process, the results were analyzed and statistically processed.

Weight Measurement

- **Test Purpose:** Total Weight.
- **Performance description:** The test subject stands upright on the scale so that the weight is distributed evenly on the feet. Then the reading that appears on the screen is taken to the nearest (0.50) gram, then the weight is recorded on a special weight form.

Standing Long Jump Test (Ali Saloum. 2004)

- **Purpose of the test:** To measure the explosive power of the leg muscles.
- **Equipment Required**

b) A flat area suitable for measuring the jump, 1.5 meters wide and 3.5 meters long.
c) A measuring tape to measure the distance.
d) Colored pieces of chalk to mark the points.
e) Performance Description.
f) The tester stands behind the starting line with their feet slightly apart and parallel, with the toes touching the starting line. The tester begins by swinging their arms backward with their knees bent and leaning slightly forward. They then jump forward as far as possible using a strong push from the feet and extending the knees, moving their arms forward to help achieve maximum range.

- **Recording Calculation Method:**

a) Performance is measured from the starting line to the farthest point of the body touching the ground after the jump.

Third: Experimental Test

On October 17, 2024, at 11:00 AM, the support team conducted an experiential test on (3) players from the Baghdad Karkh Education First Futsal Team. The test resulted in the following:

a) Verifying the validity of the tools and equipment used.
b) Verifying the suitability of the tests and their understanding by the sample.
c) Identifying any potential obstacles encountered during the main test.
d) Verifying the validity and competence of the support team.

Fourth: Pre-test

At 4:30 p.m. on Tuesday, October 22, 2024, and Wednesday, October 23, 2024, the researchers, with the assistance of the support team, conducted a biochemical test and a physical test (explosive Power) on the research sample of the experimental and control groups, respectively, at the Bayaa Laboratory and the Bayaa Sports Activity Stadium in Baghdad.

Fifth: Mechanism of Taking the Nutritional Supplements Used (Iron)

Specific doses of iron were administered to the players according to the ratios shown in the pre-tests. This coincided with the implementation of the training curriculum for 8 weeks, divided into 24 training units at a rate of 3 units per week. Players in the first experimental group took the nutritional supplements daily, starting with the first morning training unit after completing their workout, and continuing until the end of the experimental period, while ensuring they drank sufficient amounts of water. The second experimental group relied solely on the training curriculum from the first training unit until the end of the experimental period, without using nutritional supplements.

Main Experiment

The researchers administered specific doses of iron in conjunction with the training curriculum to the first experimental group. This was conducted over a period of 8 weeks, divided into 24 training units, at a rate of three units per week, during the special preparation period and before competitions. The main experiment began on Sunday, October 27, 2024, and continued until Friday, December 27, 2024, at a rate of three days per week (Sunday, Tuesday, and Thursday). These units included a major component focused on developing the physical aspect using the repetitive training method.

Competitive physical exercises, designed to develop explosive Power, were included in the research sample (the experimental group) during the special preparation period. To ensure accurate measurement of training intensity, the researchers relied on a Polar M430 device to accurately determine the required intensity. The repetitive training method was used within the training units, with exercise intensity set to range between 90-98% of the players' maximum intensity. The monthly training intensity was distributed according to a well-thought-out plan to ensure the achievement of the desired goals. The monthly intensities were distributed as follows:

a) First month intensity: 90-94%.
b) **Second month intensity:** 95-98%.
c) **Average intensity of the total program:** 94.25%.

The researchers distributed the components of the training load based on determining the maximum intensity of the players' abilities using two Polar m430 devices. Rest periods were determined based on pulse measurements using the same device to adjust training rest periods. Rest periods between sets were (3) minutes. Regarding determining exercise volumes, the researchers relied on repetition as the basis for planning training units, ensuring the accurate and efficient achievement of the training program goals.

Sixth: Post-test

In cooperation with the support team, the post-test was conducted on the study sample on Monday, December 30, 2024, at 4:30 PM. The tests were conducted over two days at the Bayaa Laboratory and the sports activities stadium in Bayaa, Baghdad, taking into account the standardization of time, location, and measurement tools. The tests included measuring explosive Power for both the experimental and control groups, aiming to assess the level reached by the players and the extent of their progress. These tests focused on examining the effect of taking the proposed nutritional supplements and implementing the training curriculum for the experimental group, compared to the control group.

Statistical Methods: The search data was processed through the Statistical Package for the Social Sciences (SPSS).

Results and Discussion

First: Presentation of the results and analysis of the pre- and post-test hemoglobin for the experimental and control groups

Table 2: Show the arithmetic means, standard deviations, and (T) value for the hemoglobin variable for the experimental and control groups.

Statistical parameters variable	Unit of measurement	Pre-test		Post-test	
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
Experimental hemoglobin	mg	10.462	0.442	13.015	0.379
Control hemoglobin	mg	10.440	0.182	10.8500	0.405

Below the significance level of (0.05) and with a degree of freedom of (7).

Table 3: Shows the difference in arithmetic means, standard deviations, and the (T) value for the hemoglobin variable for the experimental group.

Statistical parameters	Unit of measurement	arithmetic mean of difference	standard deviation of differences	standard error of the mean difference	T value calculated	Level Sig	Type Sig
Experimental hemoglobin	mg	2.352	0.4655	0.022	11.002	0.000	Sig
Control hemoglobin	mg	0.300	0.2827	0.0288	1.780	0.014	Sig

Below the significance level of (0.05) and with a degree of freedom of (7).

Second: Presentation and analysis of the explosive power results for the pre- and post-tests of the experimental research sample

Table 4: Show the arithmetic means and standard deviations for the explosive power variable for the experimental group.

Statistical parameters variable	Unit of measurement	Pre-test		Post-test	
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
Explosive power of the experimental group	cm	246.364	11.572	251.50	10.0
Explosive power of the control group	cm	241.12	9.22	246.37	7.058

Below the significance level of (0.05) and with a degree of freedom of (7)

Table 5: Shows the difference in arithmetic means, standard deviations, and the value of (T) for the explosive power variable for the experimental group.

Statistical parameters	Unit of measurement	arithmetic mean of difference	standard deviation of differences	standard error of the mean difference	T value calculated	Level Sig	Type Sig
Explosive power of the experimental group	cm	4.025	6.561	2.618	1.782	0.100	non sig
Explosive power of the control group	cm	3.150	6.6597	1.643	1.449	0.155	non sig

Below the significance level of (0.05) and with a degree of freedom of (7).

Third: Discussion of the results of the pre- and post-test for the experimental and control groups:

The results shown in Table (3) indicate significant differences in blood hemoglobin levels. The researchers attribute this to the training curriculum, which was accompanied by the use of iron. This had a clear impact on blood hemoglobin levels and, consequently, on performance. Iron is an important mineral in the human body and plays a major role in transporting oxygen from the lungs to all parts of the body via hemoglobin, which is found in red blood cells. It constitutes two-thirds of the body's iron supply. This means that iron deficiency affects various bodily functions, from brain functions to the immune system (Mary Jane Brown. 2013) this is what the study confirmed.

Regarding the random differences in explosive Power, the researchers attribute this to the components of the training curriculum implemented by the trainer and prepared by the researchers, under the supervision of the researchers themselves, with the assistance of the work team, and in accordance with the mechanism for regulating the use of supplements used in the study among the experimental research sample, whose training curriculum relied on the use of nutritional supplements with specific exercises. The researchers attribute this relatively small improvement, which is not evident in the statistical parameters of explosive Power, to the scientifically prepared explosive Power. Emphasized that "explosive Power training certainly means using appropriate, specific exercises derived from specialized effectiveness, because these exercises will create

neuromuscular coordination in the working muscles and develop their ability to perform.

In addition, the researchers attribute these differences to the cycle of lengthening and shortening muscle fibers to produce a movement characterized by great Power in a short period of time, which positively reflects on the development and improvement of explosive Power in the leg muscles (Gambetta V. 1989) [6]. Hence, the significant differences in favor of the first experimental group resulted.

There were significant differences in blood hemoglobin levels and explosive power using the t-test, with the experimental group showing a marked improvement in the post-tests. Researchers attribute this improvement to the effectiveness of compound exercises, which rely on integrating two or more basic skills into an organized motor performance, contributing to the development of physical abilities. These exercises were designed based on accurate readings from a GPS tracking device, and the training program was meticulously prepared to determine the level of intensity, rest periods, and number of repetitions required. (Al-Khashab 1999) [15] explained that "compound exercises contribute to the development of players' physical qualities and functional abilities, helping the body adapt to high physical effort and different playing conditions." (Al-Saffar 1987) [14] emphasized that these exercises "allow the player to acquire more than one skill or physical ability during training." According to (Qassem *et al*., 2011) [11], "the extent of neural response and its compatibility with muscular response to perform movements in the shortest possible time is a crucial factor for executing motor tasks." This helps balance external and internal training loads, while enhancing intense neuromuscular responses for short periods.

This performance was developed through compound exercises that included defensive tasks such as intercepting the ball and marking opposing players. (Jawad, 2019) [9] described these exercises as "complex exercises that should be exciting, in addition to their importance in raising the player's motor and skill efficiency in various playing situations, as well as their cognitive, cognitive, and physical importance." The combination of these elements is believed to be an important motivator for athletes, pushing them to complete exercises with greater accuracy, speed, and intensity (Bastawisi, 1999) [1] noted that "high-intensity training is one of the basic training methods for improving physical capacity based on achieving adaptation between the recommended work and rest periods." (Muhammad Redha Ibrahim and Mahdi Kazim Ali) also explained that diversifying exercises helps break athletes' boredom and motivates them to train effectively. Compound exercises performed with the help of these devices significantly improved the experimental group's performance. The training curriculum developed by the researchers also played a key role in developing speed endurance through systematically increasing loads, taking into account the difficulty of the exercises and starting training gradually. Emphasized the importance of this gradual progression in designing exercises to achieve the required physical adaptation and improve performance, saying, "If the difficulty of an exercise is increased within the same training session, a gradual progression from easy to difficult, from the known to the unknown, must be considered.

Table 6: Shows the arithmetic means and standard deviations of the explosive power and hemoglobin variables for the experimental group for the post-test

variables	Experimental group		Control group		T value	Level Sig	Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
hemoglobin	13.015	0.379	10.8500	0.405	7.159	0.000	Sig
explosive power	251.50	10.0	246.37	7.058	1.013	0.180	non sig

Fourth: Discussion of the results between the experimental and control groups for the post-test.

In the explosive Power test, when statistically processed under a significance level of (0.05) and with a degree of freedom of (14) to obtain the calculated T value, the calculated T value was (1.013) at an error level of (0.180), indicating the randomness of the differences between the two groups. Meanwhile, the calculated T value for hemoglobin was (7.159) at an error level of (0.000), indicating the significance of the differences in favor of the experimental group.

The gradual increase in training loads, whether in terms of intensity, volume, rest periods, or load components in general, which follows the principle of transitioning from easy to difficult (as in compound exercises), is a key factor that has contributed to the development of speed endurance exercises. pointed out the importance of this gradual approach, emphasizing its role in improving physical performance and enhancing players' ability to adapt to the increasing demands of training. He said, "The increase in gradualism will require athletes to implement training requirements within the limits of their capabilities and functional abilities at the beginning of each new training period or phase in order to achieve new adaptations that will raise their level to the highest possible level" (Ibrahim *et al*., 2013) [13].

The researchers confirm the validity of the rationale for the experimental group's transition to using compound (physical) training modules as an effective means of developing physical performance. This is based on enhancing the adaptation of muscle groups and their acclimatization to motor tasks, which enhances the ability to adapt to physical effort and respond positively to it. Compound exercises are considered one of the diverse and essential means of developing a soccer player, as they follow movement paths derived from the game and combine more than one skill and physical ability. These exercises are performed under conditions similar to those of official matches, as confirmed by (Haitham Jawad and Maab Fathi. 2024) in their research Researchers confirm this by observing improvements in players' explosive power during compound training and official matches. Data recorded by the Polar m430 device showed a significant improvement in this aspect. (Athir Muhammad Al-Jumaili and Ahmed Abdul Amir Al-Alwani. 2023) [14] (Haitham Jawad and Haider Taha. 2024), who emphasized the importance of compound training in improving explosive power and enhancing players' physical performance, highlighted this point. stated, "An athlete's ability to perform various

repetitive transitional movements, where the athlete's body covers certain distances in the shortest possible time" (Al-Jumaili *et al*., 2023) [4]. This was witnessed. (Incorporating various exercises into training curricula in a precise manner in order to maintain the athlete's desire to carry out the requirements of strenuous training and transform them from a state of boredom and tedium to a state of happiness, joy, and enjoyment during training.) (Ibrahim *et al*., 2013) [13]. also confirmed it: "In order to progress and advance in the training curriculum, work is done to make the exercises more difficult as they progress, to achieve the continuity and challenge of the body's systems and achieve development." (Fadhel Kamel Madhkur and Amer Fakher. 2008) [5] "Through organizing the training curriculum, which was determined in a precise manner in terms of the scientific time period for intensity, rest, and repetitions, which contributed to the harmony of the external training load with the internal load, which in turn led to the development of speed endurance within the players' capabilities and abilities in conditions similar to a match. The absence of a competitive atmosphere in training leads to boredom and failure to perform repetitions correctly, meaning (with the same intensity).

Conclusion and Recommendations

Conclusion

- Compound exercises (physiological and physical) based on Polar m430 readings for the experimental group had a significant impact on improving the physical component (explosive power).
- It is essential that each player use a Polar m430 dedicated to them in order to develop explosive power.
- The training approach accompanied by the use of iron contributed to an increase in blood hemoglobin levels within the normal and targeted range, and this benefited the first experimental group over the second, with standardized doses of iron.

Recommendations

- Emphasize the need to use monitoring devices to improve other physical aspects of their training.
- Select other nutritional supplements to work with physical and skill capabilities and determine the extent to which these are affected by the supplements used.
- Conduct a study to determine the effect of physical activity on hormonal activity when using nutritional supplements.
- Conduct similar studies on a sample of female futsal players.

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Appendices

Appendix (1) Sample training units and exercises

Training unit: First

Venue: Al-Bayaa Stadium - University of Baghdad

Week: First

Date of training unit: Sunday, October 27, 2024

Month: First

Goal: Explosive power

Main section of the training unit during the special preparation period.

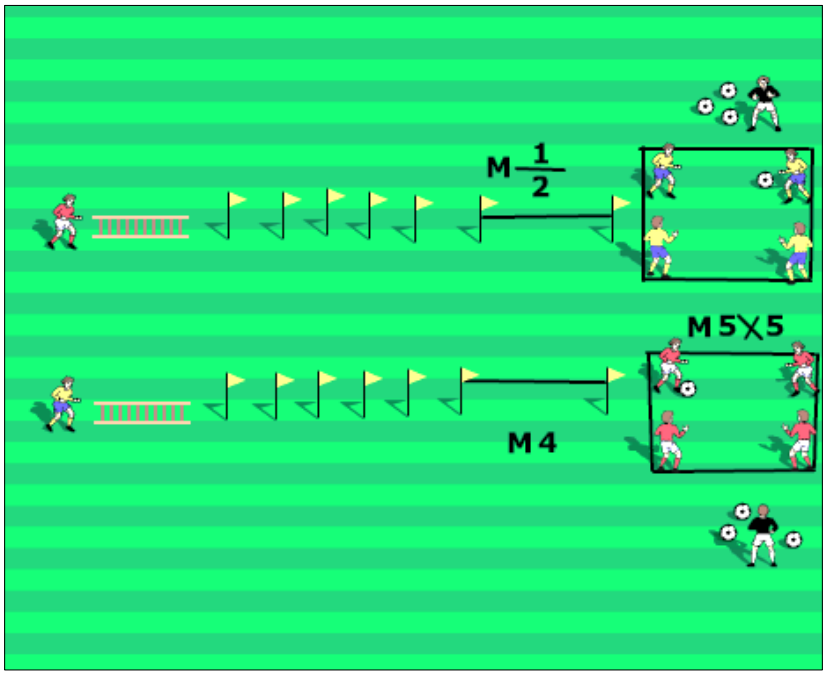
Exercise Name	Intensity	Performance or repetition time	Intermediate rest	Repetition	Sets	Rest between Sets	total time
Exercise Explosive Power (1)	%88	25sec	2min	3	2	2.5min	13min
Exercise Explosive Power (4)	%85	25sec	2min	3	2	2.5min	13min

Second: Exercises

Explosive Power Exercise (1)

The goal of the exercise is explosive Power.

The exercise is conducted in two groups. Each group of players has a ladder, (5) agility sticks, a half-meter-high, (4)-long elastic rope, and then a (5x5) meter square containing (4) players with the same equipment, with a number of players on the other side. At the beginning and end, there is a coach with balls. Upon hearing the first whistle, a player from each group jumps horizontally, passes between the agility sticks, and jumps vertically overhead with both feet, right and left. Then (4 vs. 1), the game becomes competitive in a square, and time ends with a whistle.



Appendix (2): Photos of the Polar m430 device