



The Effect of Special Exercises Using a Proposed Magnetic Device on the Development of Certain Motor Abilities in Youth Soccer Players

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Abstract

A magnetic resistance device called the Magnetic Legs Box has been designed and manufactured. It is a training device aimed at resisting the player's movement during jumping or transitioning, similar to natural joint movements. The magnetic device possesses several distinct characteristics such as consolidating force in one direction without dispersion, resulting in direct reactions from the working muscles. Additionally , it adds an element of excitement and stimulation for the players. The device enhances the leg muscles' capacity crucial for football players to improve their performance levels. It also aids in developing some motor skills making it one of the best solutions to elevate the performance of young football players and achieve better achievements in the future. The researcher designed specific exercises on the proposed device and incorporated them into a training program to enhance some motor skills for the age group of 15-16 football players from Al-Zawraa Sports Club. The researcher utilized experimental design for both the experimental and control groups, with pre- and post-observation controlled experiments, coupled with processing to suit the nature of the research problem. Positive results were observed after conducting pre- and post-tests on the players favoring the experimental group. The device had a positive impact on developing some motor skills for young football players. Based on the results the researcher recommends directing efforts towards manufacturing various training devices utilizing magnetic attraction force for different sports activities aiming to provide opportunities for all athletes to benefit from these devices.

Keywords: magnetic device, motor skills, junior football players.

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Introduction

Soccer is characterized by its enjoyment and excitement , as it combines physical , mental and technical aspects. This has attracted considerable attention from millions of people worldwide particularly as a result of the noticeable development in players’ performance and the improvement of their technical and physical levels through the use of advanced technologies . These developments range from modern training methods to technologies used for match analysis and the assessment of players’ performance levels and physical abilities during matches. Decades of development and innovation have also contributed to the emergence of a wide range of advanced products and equipment designed to improve technical skills, physical fitness, recovery and players’ overall health (Hamdan & Ghazi, 2020) .

Soccer involves complex strategies and tactics aimed at developing players’ muscular , motor and physical abilities to control the course of the match through the organization of defensive and offensive patterns. Playing styles and formations vary as soccer matches may be tactical and defensive or open and offensive, depending on each team’s strategy and objectives (Farhan, 2022). Sports training in its various forms represents a process that plays an important role in the field of competition. It is a means rather than an end providing individuals with the opportunity to perform their duties at the highest possible level. It also contributes to improving athletic achievement and enabling athletes to reach advanced levels in their respective activities while developing the components of physical fitness in general (Hussein, 2023). “No human activity can be performed without muscular strength as it represents one of the most important components of human activity. Through muscular strength all motor processes necessary to accomplish a required task are performed. Muscular strength can therefore be regarded as the foundation of human activity and the primary source of any movement performed by an individual; without it such movements cannot be executed. This demonstrates that a person cannot maintain a level of activity and movement without maintaining muscular strength” (Al-A’ithi, 2011).

Accordingly the researcher developed the idea of manufacturing a device designed to develop the strength of the leg muscles which are particularly important for soccer players in improving their performance. The researcher hopes that the device will be useful in developing certain motor abilities and will contribute to finding practical solutions that may help improve the performance level of youth soccer players and enable them to achieve better performance outcomes in the future (Ali, 2021).

The need to use devices and equipment in muscular strength training has become increasingly important and has gained considerable attention in soccer players’ training. However some of these devices and equipment have certain limitations in training practice. These may include restricting the body’s center of gravity during performance applying an unbalanced load to certain parts of the body or affecting joint ligaments and the angles of muscular action. Therefore the researcher sought to develop a device that differs from previously used equipment by adopting modern technology based on floor magnetization. This design allows the body’s center of gravity to remain relatively unrestricted and reduces excessive pressure on certain body parts thereby helping to minimize the risk of injury. In addition, the device may contribute to increasing motivation and excitement during training by reducing the routine and boredom associated with continuously repeating conventional exercises (Taher & Al-Hasani, 2020).

Through the researcher’s observation of Iraqi youth soccer league matches it was noted that there was weakness in upward propulsion and jumping ability, as well as deficiencies in

players' balance , rotational movements and speed of changing direction. These deficiencies may negatively affect their technical performance, indicating a need to develop muscular strength and certain motor abilities among youth soccer players.

The research aimed to design special exercises using the manufactured Magnetic Legs Box device to develop certain motor abilities of the lower limbs that contribute to improving jumping and upward propulsion among youth soccer players . It also aimed to identify the effect of the special exercises performed using the manufactured device on the development of certain motor abilities among youth soccer players .

The researchers hypothesized that there would be no statistically significant differences between the pre- and post-test results of the experimental and control groups in favor of either test. They also hypothesized that there would be no statistically significant differences between the experimental and control groups in the post-test results in favor of either group .

The significance of the research lies in developing the muscular strength of the lower limbs in general and standing vertical jumping ability in particular in soccer as these abilities contribute significantly to improving players' performance and developing certain motor abilities during match play. Improved jumping ability enables players to perform standing and moving jumps more effectively during competition .

The primary objective of sports training is to enable players to reach a high level of physical, motor, and technical performance in the aspects targeted by training. In this context innovative locally manufactured devices can be used at an affordable cost to the researcher as alternatives to some conventional devices and equipment designed to develop muscular strength and achieve the desired level of physical development despite differences in the mechanical characteristics of the resistance provided by each device .

The magnetic device is characterized by several distinctive features including concentrating the applied force in a single direction and minimizing its dispersion thereby producing a more direct response from the working muscles. In addition, the device introduces an element of motivation , excitement and novelty for the players, helping to reduce the monotony associated with repetitive training. Therefore, the significance of this research lies in employing a magnetic device to develop muscular strength and coordination abilities among youth soccer players .

Methods and Tools

The researcher employed an experimental design involving experimental and control groups, with controlled pre- and post-test measurements and an intervention applied between the two measurements. This design is used when comparing two groups. the researcher adopted a controlled experimental approach because it was appropriate to the nature of the research problem under investigation.

Table 1. *Experimental Design for the Experimental and Control Groups*

Group	Pre-Tests	Experimental Design	Post-Tests
Control Group	Tests of Certain Motor Abilities	Proposed Research Method	Tests of Certain Motor Abilities
Experimental Group	Tests of Certain Motor Abilities	Special Exercises Using the Magnetic Legs Box Device	Tests of Certain Motor Abilities

Table 2. Homogeneity of the Research Sample in Certain Anthropometric Measurements

Variables	Unit	n	Mean	Median	Standard Deviation	Skewness
Height	cm	10	171.9	173	3.478	0.371
Weight	kg		63.6	63	2.716	0.778
Age	years		15.5	15.5	0.527	0.000
Training Age	years		2.90	3	0.373	0.166

Data Collection

The tools , equipment and auxiliary means used are among the important requirements for conducting and completing the experiment. Research instruments represent the means through which the researcher can collect data and address the research problem in order to achieve the objectives of the study, regardless of whether these instruments consist of data , samples , devices or other materials (Wajih, 1988, p. 133) .

1. Arabic and foreign sources and references .
2. Observation .
3. Personal interviews .
4. Testing and measurement .
5. The Internet .

Equipment and Devices Used

1. Special innovative sports shoes designed for use with the device .
2. An innovative device operating using magnetic resistance .
3. Bauer device for measuring heart rate .
4. MacBook Air computer, manufactured in the United States .
5. Two Nikon video cameras, manufactured in Japan .
6. Whistle .
7. Stopwatch .
8. Cones .
9. Measuring tape .
10. Plastic rings .
11. Balance testing device .
12. Two moving targets .
13. Five soccer balls .
14. Numbered paper cards .
15. Electronic scale for measuring magnetic attraction force

Conceptual Details

The concept of the Magnetic Legs Box device was developed through the researcher's review of various sports training devices . The idea involved designing a magnetic-resistance training device that provides resistance to the player's movements during jumping or locomotion in a manner similar to the natural movements of the joints . The device consists of several interconnected components, each serving a specific function or purpose . The

components were designed to facilitate easy assembly and disassembly with some parts being fixed and others being movable and interchangeable .

The concept of the device is based on establishing a resistance that restricts the player's movement and attempts to prevent upward jumping or forward movement through magnetic attraction force . Specific resistance levels can be selected by controlling the electrical current and the number of coils used. The device also includes specially designed footwear fitted with metal components on the underside which are attached over the athlete's original sports shoes to facilitate movement and performance. After consulting specialists in electrical and mechanical engineering and discussing various proposals regarding the device's design, as well as presenting the concept to experts in the field of sports training the researcher under the guidance of the supervisors initiated the first stages of manufacturing the device on November 11, 2023 .

Resistance exercises and weighted loads placed on the athlete's body are commonly used to develop strength-power abilities. Other methods include the use of multi-gym equipment and elastic resistance bands . These types of resistance generally apply a vertical force toward the ground which may place additional stress on the spine and muscles and potentially contribute to certain injuries or physical strain . the proposed device generates a pulling force directed toward the ground through magnetic attraction. This represents a different form of resistance that allows the muscles to work against a novel resistance mechanism, which constitutes one of the main rationales for designing the device .

The device provides an element of excitement and novelty because it operates through a different resistance mechanism from conventional training equipment . This may increase players' motivation and willingness to participate in training and perform the prescribed exercises .

Motor Ability Tests

1. Coordination Test

Motor Coordination Test (Numbered Circles Test) (Abdel-Fattah, Y., 2004, p. 103)

Purpose of the Test: To measure leg–eye coordination.

Equipment Used:

- Stopwatch.
- Eight circles drawn on the floor , each with a diameter of 60 cm , numbered as illustrated in Figure (1) .

Test Instructions: The participant stands inside Circle No. (1). Upon hearing the starting signal , the participant jumps with both feet together into Circle No. (2) , then Circle No. (3) , and continues in the same manner until reaching Circle No. (8) , performing the sequence at maximum speed.

Scoring:

- The time required by the participant to move through the eight circles is recorded to the nearest tenth of a second .
- Three trials are performed. If the participant makes an error in any of the circles, the trial is repeated .



Figure 1. Illustrates the Coordination Test

2. Agility Test With and Without the Ball

Test Name: Arrowhead Test for Measuring Agility With and Without the Ball (Topend Sports, 2008) .

Purpose of the Test: To measure agility .

Equipment: Eight cones, a stopwatch, a whistle and a regulation soccer ball.

Performance Specifications: The cones are arranged with a distance of 1 meter between each cone . The distance between the starting point and Point (A) is 10 meters while the distance between Point (A) and Point (B) is 5 meters and the distance between Point (A) and Point (C) is 5 meters. The test consists of two trials: one performed toward the right and the other toward the left. Upon hearing the whistle the participant runs from the starting point through the designated course until crossing the finish line as illustrated in Figure (2) .

Performance Conditions: The participant must avoid touching the cones during the test and must follow the designated running course .

Scoring: The time taken by the participant from the starting signal given by the examiner until crossing the finish line is recorded . Each participant performs one trial without the ball and another trial with the ball, and the results of the two trials are recorded separately .

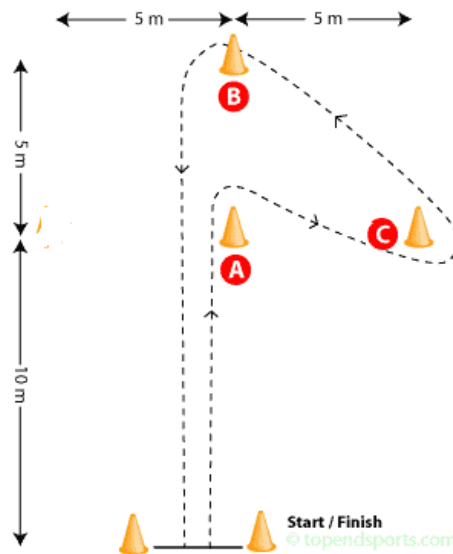


Figure 2. Illustrates the Agility Test

3. Modified Static Balance and Applied Force Test (Radhi, 2017, p. 63)

Purpose of the Test: To measure the duration of static balance and the applied force exerted by both feet during balance .

Equipment Used: A modified static balance and applied force testing device, for which a patent has been obtained .

Test Procedure: The examiner provides a detailed explanation of the operating procedure of the device and the required performance allowing the participants sufficient time to become familiar with and practice using the device before testing . The participant stands on the device and once a stable balance position is achieved and the participant is ready to perform the test the timer begins recording the performance duration through the time display . The applied force exerted by each foot is simultaneously measured through the force displays . When either of the two plates comes into contact indicating that the upper plate has tilted toward one side the timer stops , representing the duration of static balance. The force displays also stop and show the amount of applied force exerted by each foot. Each participant is given two trials and the better result is recorded.

Scoring: Static balance is measured as time (seconds)



Figure 3. Illustrates the Balance Test

Pilot Study

On Thursday, February 22, 2024 at 3:00 p.m. the researcher conducted a pilot study involving three players who were not included in the main research sample . The purpose of the pilot study was to familiarize the assisting research team with the procedures for administering the selected tests assess the capabilities and readiness of the assisting team determine the time required to perform the tests and evaluate the efficiency and validity of the tests used in the study .

Procedures

Pre-Test

After obtaining the required official approvals from Al-Zawraa Sports Club the researcher conducted the pre-test for the research sample at 4:00 p.m. on Saturday , February 24, 2024 The participants underwent tests to assess certain motor abilities as presented in Table (3) .

Table 3. Normal Distribution of the Sample in Certain Research Variables

Variables	Unit	n	Mean	Median	Standard Deviation	Skewness
Coordination	s	10	8.685	8.52	0.335	1.172
Agility Without the Ball	s		9.362	9.38	0.056	−0.383
Agility With the Ball	s		11.519	11.53	0.043	−0.965
Balance	s		2.021	2.085	0.274	−0.526

One of the requirements of the experimental design adopted in this study was to determine the baseline level of the two research groups in the pre-tests . The research sample was randomly divided by drawing lots into two groups : an experimental group consisting of 5 players and a control group consisting of 5 players . The researcher established the equivalence between the experimental and control groups using the independent-samples t-test to determine the statistical significance of the differences between the two groups , as presented in Table (4).

Table 4. Equivalence of the Two Research Groups

Variables	Unit	Control Group		Experimental Group		t-value	p-value
		Mean	± SD	Mean	± SD		
Coordination	s	8.78	0.417	8.59	0.238	0.884	0.403
Agility Without the Ball	s	9.358	0.064	9.366	0.055	0.210	0.839
Agility With the Ball	s	11.520	0.046	11.518	0.046	0.068	0.947
Balance	s	1.970	0.236	2.072	0.322	0.566	0.587

Experimental Training Program

The researcher prepared a set of special exercises using the designed device from Monday , February 26, 2024 to Saturday , April 27, 2024 with the aim of developing muscular strength . The training program consisted of 24 training units, with 4–6 exercises included in each training unit. The intensity of the exercises ranged from moderate to high and the exercises were performed three times per week. The duration of the exercises ranged from 20 to 30 minutes per training unit .

The special exercises were incorporated into the training sessions designated for developing muscular strength in accordance with the planned training program . The intervention was implemented during the competition and semi-competition phases with the use of high-intensity interval training (HIIT) . The researcher also adopted the principle of exercise variation and repetition to ensure training diversity and continuity . Some exercises involved the use of a soccer ball and were performed while using the designed device whereas other exercises were performed without the ball and focused on physical movements using the device .

The control group meanwhile continued its regular training program under the supervision of the team coach without using the designed magnetic device .

Post-Test

The researcher conducted the post-test on Monday April 29, 2024 following the same procedures and conditions as those used in the pre-test for the research sample .

Statistical Analysis

The researcher used the Statistical Package (SPSS) to analyze the research variables and obtain the required statistical measures including the mean, median , standard deviation , Pearson correlation , paired-samples t-test and independent-samples t-test.

Results

Table 5. Means , Standard Deviations , Differences and Calculated t-Values for the Pre- and Post-Tests of Motor Abilities in the Control Group

Variables	Unit	Pre-Test		Post-Test		Mean Difference (D)	SD of Differences	t-Value	p-value	Development Rate
		M	SD	M	SD					
Coordination	s	8.780	0.417	8.686	0.393	0.094	0.034	6.119	0.004	1.1%
Agility Without the Ball	s	9.358	0.064	9.304	0.065	0.054	0.005	22.040	0.000	0.5%
Agility With the Ball	s	11.520	0.046	11.462	0.034	0.058	0.031	4.164	0.014	0.5%
Balance	s	1.970	0.236	2.188	0.121	0.218	0.353	1.379	0.240	9.9%

df = 4 , $\alpha = 0.05$.

Table 6. Means , Standard Deviations , Differences and Calculated t-Values for the Pre- and Post-Tests of Motor Abilities in the Experimental Group

Variables	Unit	Pre-Test		Post-Test		Mean Difference	SD of Differences	t-Value	p-value	Development Rate
		M	SD	M	SD					
Coordination	s	8.590	0.238	8.248	0.088	0.342	0.246	3.097	0.036	3.9%
Agility Without the Ball	s	9.366	0.055	9.200	0.015	0.166	0.051	7.170	0.002	1.7%
Agility With the Ball	s	11.518	0.046	11.382	0.037	0.136	0.023	13.209	0.000	11%
Balance	s	2.072	0.322	2.630	0.386	0.558	0.201	6.179	0.003	21%

df = 4 , $\alpha = 0.05$.

Table 7. Results of the Differences Between the Experimental and Control Groups in the Measurement of Motor Abilities

Variables	Unit	Control Group		Experimental Group		t-Value	p-value
		Mean	± SD	Mean	± SD		
Coordination	s	8.686	0.393	8.248	0.088	2.429	0.041
Agility Without the Ball	s	9.304	0.065	9.200	0.015	3.474	0.008
Agility With the Ball	s	11.462	0.034	11.382	0.037	3.482	0.008
Balance	s	2.188	0.121	2.630	0.386	2.442	0.008

df = 8 , $\alpha = 0.05$.

Discussion

The results of the statistical analysis of the data obtained from the experimental and control groups, using the independent-samples t-test revealed statistically significant differences between the two groups in the development of the investigated motor abilities, namely coordination, agility without the ball , agility with the ball and balance, in favor of the experimental group that performed the special exercises using the manufactured device. These findings indicate that the proposed training intervention contributed to improving the motor abilities of the youth soccer players. Motor abilities are directly associated with muscular and

neuromuscular function and with the body positions adopted during performance particularly in activities requiring rapid muscular contractions and a high rate of force development .

Regarding agility it is closely associated with other motor abilities because of its complex nature . This characteristic results from the relationship between agility and physical abilities on the one hand and the motor performance itself on the other. Mufti Ibrahim (2001) stated that agility has a special position among physical attributes because it is associated with various physical and motor abilities (Hammad, 2001, p. 199) . The researcher attributes the superior results of the experimental group to the resistance exercises performed using the designed device. The magnetic resistance increased the resistance acting against the movement of the body or its segments thereby providing an opportunity to train strength under magnetic resistance and enabling the players to employ greater levels of force and speed to overcome the imposed resistance . This contributed to improving movement efficiency and agility . Agility refers to “the ability to change direction rapidly and with proper timing” (Salama, 2000, p. 158) which reflects the player’s ability to rapidly change body positions and direction , whether through the movement of the entire body or individual segments, as a result of improved muscular strength.

With regard to dynamic balance balance is defined as “the ability to maintain body stability while performing various movements whether during movement or in a stationary position. It also refers to the individual’s ability to control the positions of different body segments through the effective functioning of the nervous system in controlling the muscular system” (Al-Fadhli & Al-Bayati, 2012, p. 274) . The researcher considers the superior results of the experimental group to be attributable to the resistance exercises performed using the designed device. During movement the magnetic resistance generates an opposing force directed toward the ground. This force requires the player to exert muscular effort to overcome the external resistance and maintain body stability. The muscles must therefore produce sufficient force to counteract the external forces acting on the body . As Al-Fadhli (2010, p. 252) noted, muscular force is also used to resist gravity and friction and to increase the force of reaction .

In addition resistance training contributes to strengthening the stabilizing muscles which play an essential role in maintaining proper body alignment and postural control . Strong stabilizing muscles enable athletes to perform complex movements with greater control and precision which may reduce the risk of injuries associated with poor coordination . These findings are also consistent with Abdel-Fattah and Hassanein (1997, p. 175) who emphasized that the development of motor performance is associated with the continuous interaction between the nervous system which sends commands to the muscles to produce contractions and the sensory organs, which provide the nervous system with information resulting from these contractions . The role of sensory systems becomes particularly evident during the performance of different movements. Therefore , the observed improvements in the experimental group’s motor abilities can be considered consistent with the physiological and neuromuscular demands imposed by the special exercises using the designed magnetic-resistance device .

Conclusions

The researcher concluded that adopting the proposed exercises using the magnetic-resistance training device contributed to the development of anaerobic capacity and certain motor abilities among youth soccer players , including motor coordination , agility without the



ball , agility with the ball and motor balance. The proposed training intervention also contributed to improving selected skill-performance outcomes, particularly dribbling performance speed and right-side shooting accuracy among youth soccer players .

Recommendations

The researcher recommends incorporating the proposed magnetic-resistance training device into training programs for youth soccer players as an auxiliary means for developing their physical and motor abilities ; conducting training courses that integrate the proposed device with physical exercises; using the device to develop leg muscular strength in general ; encouraging researchers to design and manufacture innovative training devices based on magnetic attraction forces for different sports and physical activities to provide athletes with opportunities to benefit from such technologies and utilizing the proposed device in similar studies involving other sports, such as volleyball and basketball, among male and female athletes as well as youth and junior players .



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