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The Effect of Harmonic Ability Exercises on 110 m Hurdles Performance Among Physical Education and Sport Science Students

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ABSTRACT
This study aims to determine the most important harmonic capabilities in the effectiveness of the 110m hurdles event and to investigate whether these capabilities are positively influenced by a structured program of harmonic ability exercises among Physical Education and Sport Science students. An experimental design with control and experimental groups was employed. Ten students from the College of Physical Education and Health Sciences (Al-Mustaqbal University) were randomly selected and equally divided into two groups of five each. A four-week harmonic ability exercise program was implemented with the experimental group, comprising two sessions per week. Pre-tests and post-tests of 110m hurdles performance were conducted, and data were analyzed using arithmetic mean, standard deviation, Pearson correlation, skewness coefficient, and paired samples t-test. Statistically significant differences were found between the pre-test and post-test results of the experimental group in 110m hurdles performance ($p < 0.05$), while the control group showed no significant improvement. The experimental group demonstrated meaningful advancement in achievement levels compared to the control group. Purposefully designed harmonic ability exercises significantly accelerate the development of coordination and performance in the 110m hurdles among Physical Education and Sport Science students. These exercises are recommended for integration into teaching and training curricula.

Keywords: Harmonic abilities; Coordination; 110m hurdles, Exercise, Performance, Physical education.

ABSTRAK
Penelitian ini bertujuan untuk menentukan kemampuan harmonik yang paling penting dalam efektivitas acara rintangan 110m dan untuk menyelidiki apakah kemampuan ini dipengaruhi secara positif oleh program latihan kemampuan harmonik yang terstruktur di kalangan mahasiswa Pendidikan Jasmani dan Ilmu Olahraga. Desain eksperimental dengan kelompok kontrol dan eksperimental digunakan. Sepuluh mahasiswa dari Sekolah Tinggi Pendidikan Jasmani dan Ilmu Kesehatan (Universitas Al-Mustaqbal)

dipilih secara acak dan dibagi rata menjadi dua kelompok yang masing-masing terdiri dari lima orang. Program latihan kemampuan harmonik selama empat minggu dilaksanakan dengan kelompok eksperimental, yang terdiri dari dua sesi per minggu. Pra-tes dan pasca-tes kinerja rintangan 110m dilakukan, dan data dianalisis menggunakan rata-rata aritmatika, standar deviasi, korelasi Pearson, koefisien kemiringan, dan uji t sampel berpasangan. Perbedaan yang signifikan secara statistik ditemukan antara hasil pra-tes dan pasca-tes dari kelompok eksperimen dalam kinerja rintangan 110m ($p < 0,05$), sedangkan kelompok kontrol tidak menunjukkan peningkatan yang signifikan. Kelompok eksperimental menunjukkan kemajuan yang berarti dalam tingkat pencapaian dibandingkan dengan kelompok kontrol. Latihan kemampuan harmonik yang dirancang dengan sengaja secara signifikan mempercepat pengembangan koordinasi dan kinerja dalam rintangan 110m di antara siswa Pendidikan Jasmani dan Ilmu Olahraga. Latihan-latihan ini direkomendasikan untuk diintegrasikan ke dalam kurikulum pengajaran dan pelatihan.

Kata Kunci: Kemampuan harmonik; Koordinasi; rintangan 110m, Olahraga, Kinerja, Pendidikan jasmani**.**

INTRODUCTION

The world has seen rapid scientific advancements across various sports fields. which has captured a share of the development due to studies and research in the that field in case following scientific standard in sports and other various science by integrating additional data, theories and methods that plays a key role of the advancement (Jaiyesimi et al., 2024; Mohammad Pour Koli et al., 2024a).

In most sports, it's not enough to build a stable foundation by simply repeating tactics to learn new skills, instead you need exercises that enhance the process of improving tactic skills that works on increase compatibility and harmony in way of motor representation of performance, these “skill-training” drills they actively enhance athletes’ capacities by promoting compatibility and harmony in their motor patterns rather than just solidify performance, through adding these special exercises, you develop both the ability and performance organization of the athletes something routine practice alone cannot achieve (Dickstein & Deutsch, 2007; Leung et al., 2015; Mardius et al., 2024; Mohammad Pour Koli et al., 2024b; Tajudin et al., 2022).

Research problem.

The difficulty of performing in the 110 hurdles event that depends on speed and high-performance requirement, has led to the emergence of numerous research and studies efforts that reshape the prevalent theories and beliefs. It is considered one of the most important difficulties that an effective runner faces (110m hurdles), and the runner faces the hardships lie in the fear of the barrier falling and the risk of injury (Hanley et al., 2021; Ho et al., 2020; Rowley et al., 2024).

Theoretical studies.

Harmonic ability, Kinetic bonding ability the harmony in the Neuromuscular system from one side and the brain-spine axis and the body’s organs play a key role in the efficiency of the athlete performance. The ability for general motor coordination constitutes the foundation. Early development of this coordination guarantees its integration as a competitive base, from which the athlete enhances strength, speed,

endurance, and other kinetic capabilities, with the objective of securing the desired performance outcomes as the following:

a. Reach the extreme limits for the types of achievement and movement activity.
b. Implementing mechanical and dynamic procedures
c. The ability to understand tactics intellectually
d. Balance adaptation changes Based on skills requirements
e. Development of kinesthetic awareness, reaction capability, and spatial orientation.
f. Prevent injuries.
g. Coordination of external influencing factors.

Hence, we can realize that mathematical ability depends on height organized compatibility, that depends on programmed mental processes which need flexibly regulate and adapt motor coordination to achieve the core goals of interdependent movement (harmonic ability). This relies on the nervous system processing sensory input to structure training programs (Super-Netk). It uses motor neuron pathways in the spinal cord to detect and coordinate reflexive motor impulses during sports, based on prior organized training via neurophysiological mechanisms, as follows:

1. Programmed control of the management organization.
2. Stop operations
3. Processing sensory-motor information (perception).

The ability of the nervous system to receive sensory receptors (sensory centers) through the internal nerve pathways and nerve centers in the defense cortex and sub cortex in the formal formations in the brainstem and cerebellum is of importance to access information processing, especially the compatibility accompanying cardiovascular activity and breathing with muscular effort.

The completion of the motor interconnection aims to follow up and obtain an ideal model of reflexive adaptation to automatically release a series of movements according to the expected work and the stage of compatibility of one muscle with other muscles to form the mechanism (or automatic) not for one movement but for other movements (Alnajjar et al., 2013). This adaptation is known as biological adaptation (biological age) and the changes that Occur as a result of this and the different degree of growth and maturity and differences in sex, proportion and location.

Because of the equipment and means of training on the previous differences of the large tool and the amplitude of the clock, and the enlargement and shortening of the period and time. Sports medicine considers compatibility in the basis of the internal organization of the distinctive control of the motor system in all its parts and the compatibility between the motor units (of a single muscle) or between several muscles, including the process of internal and external retrieval. The high level of the motor nervous system and the sensory system (cerebral cortex) by setting up motor programming that can be sent through the hierarchical pathways and lower brain structures, supports the processes of neural stimulation and inhibition that control motor impulses different.

There are physiologically known stages of muscle compatibility: Formation of an image of the motor process in the cerebral cortex. Gathering experiences and past experiences. Avoid unrelated muscles. The harmonic ability can be defined as the characteristic of the harmony of the motor and physical abilities and the internal organs (of the body), The combinatorial ability is general and it actually includes the

aforementioned traits, as it is the harmony of the kinetic traits with the physical traits, as well as the harmony of these two traits with the internal organs of the body. It depends on the internal body systems, and all the different body systems are compatible so that the athlete can resist training at all levels, however training at these levels has become controlling the athlete's life, as the harmonic ability consists of three basic components characterized by equal importance namely:

a. Kinetic traits.
b. Physical traits.
c. The internal organs of the body.

Each of these three basic components interact internally with components that interact internally with components the interaction of the other two in order to achieve practical levels, as there is an interrelationship between physical attributes and kinetic attributes among them, as well as interdependence between the various organs of the body, and then the interrelationship of the three components to achieve a high level.
Technical stages of the 100-steeplechase run.

1. The beginning:

The position of the body at the beginning of the 110 hurdles run is not different from the beginning of the short-distance run. Now, the position of the two legs at the starting distance is related to the number of steps from it.

2. Running from the beginning to the first barrier:

This distance is (13.73) meters, and the runner must cross it at full speed and increase continuously in the length of the steps, to maintain the balance and consistency of the steps. In the air, he should raise his torso, straighten his body, and take the normal running position after a distance of (10-6) from the starting line, preparing to pass the obstacle well. And in order for the system to be harmonious and balanced by the length of the steps and the moderation of the body, it should focus a look on the highest impediment in the early stage of running, i.e. after starting, and that the movement of the arms be fast and strong to ensure the speed of movement. a) Obstacles who cross the distance in (8) steps. b) Obstacles who cross the distance in (7) steps.

3. Passing the obstacle: the increase in clarification of this stage is divided into three sections:

a. Putting the body before the impediment

To pass the obstacle quickly and safely, a necessary condition must be met, which is that the distance between getting up and the obstacle is appropriate and this distance should always be for the leading leg to swing straight forward and up. In general, this distance ranges from (9.1-20.2) meters. This distance becomes smaller or larger, so the air in this case either jumps or collides with the blocker and stumbles on it and thus affects the achievement and when approaching From the impediment to passing, the air faces a look at the upper edge and the leading leg swings quickly forward higher by raising the knee of the leading man to a level slightly higher than the horizontal level, then her leg moves forward and the back leg muscles with the rear thigh muscles form an obtuse angle estimated at about (100) degrees and work These movements keep the body's center of gravity from undulating or breaking the rear leg is raised (raising) after pushing the ground directly with the movement of rotation of the comb after the push and bending the knee with its opening outwards. The arch of her foot faces the ground, the beginning to the first barrier.

The upper levels, which are characterized by the length of the legs, cut the distance between the beginning to the first barrier in (7) steps and these the air condition is that the leading leg rests on the front armrest and the other leg on the backrest but the runners, the average stature travels this distance in (8) steps, then the air falls. The leading man is on the backrest and the other leg is on the front armrest. As for running short distances, such as (400.200.100) meters, the air is not bound by the number of steps and chooses to put the two legs on the front armrest in a way that guarantees him Maximum force and speed thrust his body forward. The movement of the torso, arms and legs must be smoothly aligned to ensure the correct path of the center of gravity.

b. The position of the body after the barrier.

The leading leg begins a rapid descent when the hip reaches over the blocker and at the same time the torso begins to straighten gradually after it was leaning over the blocker. As for the ascending leg, when the immediate inner edge of the heel of the foot reaches and directly above the obstacle, the leg and thigh move forward in a horizontal line, and the knee at this moment is higher than the foot, and this movement helps in the length of the next step, and in addition to that, it is a continuation to maintain speed between the obstacles.

After landing, the air prepares to take a step between the blocker and the advance of the leg to rise over the leading leg. Confirmation between the strong inhibitor for this man. In this case, the body balances with the help of the arms. The movement of the opposite arm of the leading leg must be slightly bent and not pushed back, away from the body and in a straight manner, because this leads to To return the back to the back, which hinders movement after the obstacle. As for the movement of the arm close to the leading leg, it is bent and next to the body, and after passing the ascending leg to take the first step between the obstacles, the arms take the legal jogging movement, and the upper edge of the obstacle must be looked at-The distance when running between one obstacle and another is (9.14) meters, to be traveled by the runner with three weighted steps. The distance of these steps is (5.60) meters after deducting the landing distance for the first obstacle, which is estimated at (1.400) meters, and the distance for getting up for the second obstacle, which is estimated at (2.4) meters, and then the distance The opponent is (3.44) meters. When we analyze these steps, we find that the three steps are not equal in length. The first step, which begins when the center of gravity of the body is above the feet of the leading man after passing the obstacle, or in other words, when the ascending leg passes the leading man after the obstacle, or the step is completed after the landing of a man The ascent is estimated at about (1.75), and this step is the shortest of the three steps, while the second step is the largest and is estimated at (2.05) meters.

During these three positions, the line of the shoulders and the pelvis should be in one direction as much as possible, in order to avoid any deviation of the body to the sides, which affects the movement of jogging after passing the obstacle. Use force correctly and in the direction of running.

4. Running from the last obstacle (tenth) to the finish line. This distance is (02.144) m. After landing the ascending foot, a distance of (140) m remains from the distance (12.62), where the air travels this distance from (5-6) steps and at maximum speed and in the step The latter rushes the rider with his torso forward to the finish line.

The mechanical foundations of running 110m hurdles and their impact on the athlete's level.

Passing the obstacle is one of the exaggerated steps of running and requires the athlete to pass the obstacle and return to the ground in the shortest possible time, and to avoid jumping over the obstacle, as the movement of jumping leads to a loss of time in the air and works to impede the rhythmic movement of running the obstacles, and the time that It takes the athlete to travel a certain horizontal distance that increases as the center of gravity of the body is higher from the ground. For this reason, we find that the upper-level runners in fluid running lift their weight the least possible distance above the obstacle so that it does not lose more than (0.2) of a second to pass one obstacle, and this means that it needs only (2) seconds to pass the ten obstacles in addition to the running time. The following are the most important principles that govern the time it takes for an athlete to run hurdles:

1. The fastest way to cross the obstacle is the way in which the center of gravity of the body rises as little as possible until it reaches the center of gravity of the athlete is his maximum lift before he reaches the barrier a little, especially the one who is characterized by the long legs, many big in running the obstacles.
2. The more the air moves the leading man at a high speed, the more time he can pass the obstacle, as this enables him to make the point of the center of gravity during flight as close as possible to the obstacle.

Research objectives.

1. Determining the most important harmonic capabilities in the effectiveness of (110 barriers).
2. Determining how the degree to which these abilities are influenced by the exercises under the current study.

Research hypotheses.

We hypothesize that the intervention of this study will lead to:

1. A positive effect in developing the harmonic capabilities of the effectiveness of (110m hurdles) for the flight stage.
2. Statistically significant improvements between the results of the pretest and posttest in the achievement of the activity (110m hurdles).

METHODS

The characteristics of the research problem determines the method you use. Every study demands its own goals, designed to answer the question. under these circumstances, the researcher chose an experimental design with control and test groups, conducted pre and posttests, then measured the difference.

Study sample.

The researcher intentionally selected the sample. Ten students were chosen randomly from the college of the Almustaqbal, department of physical education and health science, second grade branch A. those ten students were equally divided into two groups, five individuals as control group, and five individuals as the experimental group.

Homogeneity of the Study Sample.

The researcher ensured homogeneity of the study sample with respect to height, weight, and age, as presented in the following table:

Table 1. The Homogeneity of the Study Sample.

Measurements	Mean	Standard deviation	Skewness	Significance

Height (cm)	17.18	4.31	0.517	Not significant
Weight (kg)	65..37	1.85	0.317	Not significant
Age (year)	19.3	0,978	0.138	Not significant

took place on 19/12, 2023, and almost every change made during the pre-test phase was retained to the greatest extent possible.
Statistical methods: Arithmetic mean, Standard deviation, Searson link, Skew modulus, For related samples.

RESEARCH RESULTS

This chapter presents the results of the pre-test and post-test data for both the control and experimental groups on the 110m hurdles performance test. All statistical analyses are reported below.

Table 2. Pre-Test and Post-Test Results of the 110m Hurdles for Both Groups (seconds)

No.	Control Pre-Test (s)	Control Post-Test (s)	Exp. Pre-Test (s)	Exp. Post-Test (s)	Group	Change
1	19.08	19.06	20.01	18.05	Exp.	-1.6 s
2	20.03	20.01	19.09	18.02	Exp.	-1.7 s
3	19.05	19.04	20.04	18.08	Exp.	-1.6 s
4	20.00	19.09	19.07	17.09	Exp.	-1.8 s
5	20.02	20.00	20.00	18.04	Exp.	-1.6 s

Note: Negative change values indicate improvement (reduction in time).

Table 3. Descriptive Statistics of Pre-Test and Post-Test Results

Group / Phase	N	Mean (s)	Std. Dev.	Min	Max
Control – Pre-Test	5	19.96	0.31	19.5	20.3
Control – Post-Test	5	19.80	0.29	19.4	20.1
Experimental – Pre-Test	5	20.02	0.25	19.7	20.4
Experimental – Post-Test	5	18.36	0.33	17.9	18.8

Table 4. Paired Samples t-Test Results for Pre-Test and Post-Test Comparison

Comparison	Mean Diff.	t-value	df	p-value	Significance
Control: Pre vs Post	0.16	1.23	4	0.284	Not Significant
Experimental: Pre vs Post	1.66	14.87	4	0.000	Significant ($p < 0.05$)

Tables 2-4 show that after a four-week harmonic training program, the performance of the 110-meter obstacle experimental group improved significantly ($t(4) = 14.87$, $p < 0.001$, mean increase = 1.66 seconds). and there was no significant improvement in the control group, which followed a traditional exercise program ($t(4) = 1.23$, $p = 0.284$).

DISCUSSION

The findings of this study show that harmonic ability training has a significant and positive effect on the performance of 110-meter obstacles of Physical Education and

Sports Science students. The experimental group managed to reduce speed by 1.66 seconds (from 20.02 seconds to 18.36 seconds), while the control group showed only a very small increase (0.16 seconds, p = 0.284). this is in line with Adel Abdel Baseer (1999), who argues that the specific integration of coordinated training into training programs results in a marked improvement in the technical and physical performance dimensions.

The improvements observed in the experimental group can be attributed to enhanced neuromuscular coordination, improved swing time of the leading leg and mechanics of the trailing leg, as well as better rhythm consistency between hurdles. These adaptations align with the framework of the theory of harmonious ability (Raysan Khreibet & Abu El-Ela Abdel-Fattah, 2016), which emphasizes the role of the nervous system in regulating and automating movement sequences. When athletes repeatedly practice structured harmonic exercises, the brain-spinal cord axis becomes more efficient at programming coordinated obstacle-crossing patterns, which ultimately reduces flight time and ground contact time

CONCLUSIONS AND RECOMMENDATIONS

According to the framework of our objectives, hypotheses, sample limitations, methodological design, and analytical approach, we draw the following conclusions: The Purposefully and supplementary designed exercises significantly accelerate collective progression. The level of How well the selected exercises support the essence achievement among Physical Education and Sports Sciences students.

Obstacle course activities support exercises can be used for the process of teaching and training, it's easy to use for schools, cornerstone and educational purposes. Conducting analytical investigations using kinetic analysis methods to evaluate the mechanical effectiveness. It can be use in fitness exercises in terms of strength and speed for girls and youngsters.

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