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The effect of rapid strength training in a water environment according to the Obstructive force index on some kinematic variables for the start phase and achievement of the 100-meter Sprint

Abu Al-Hassan Raouf Mahmoud [1], **Alaa Muhsun Yasir** [2]

[1,2] University of Baghdad, College of Physical Education and Sports Sciences

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Abstract

The study aimed to prepare rapid strength training in a water environment according to the obstructive force index for 100-meter Sprint. To identify the values of some kinematic variables for the start and achievement stage for the research sample. To identify the effect of rapid strength training in a water environment in developing some kinematic variables for the start and completion stage of running (100 m Sprint between the test (pre-post) for the research sample. The researchers used the experimental method by designing two equal groups with a pre- and post-test to suit the nature of the research problem. The research sample was identified with track and field runners for the 100-meter event in Maysan Governorate over the age of 20 years. The number of athletes 2023-2024 is (8). They will be taken completely by the comprehensive inventory method. They constituted 100% of the research community. The researchers concluded that performing rapid strength training exercises according to the aquatic medium whose intensity is regulated according to the law of obstructive force had a positive impact on Kinematic variables for the start and completion stage. The most important recommendations which the researchers recommended are: the necessity of using rapid strength training in the aquatic medium because of this medium's effective impact on developing muscular strength and then achievement. The of adopting the law of obstructive force to codify the training intensities for fluids (the aqueous medium) in training. Fast running and all games necessity.

Keywords: rapid force, obstructive force index, kinematic variables, starting phase, achievement, 100 metres Sprint.

[1] Abu Al-Hassan Raouf Mahmoud, Post Graduate Student (phd)) ,University of Baghdad, College of physical Education and Sport Sciences,(abu.raouf2104p@cope.uobaghdad.edu.iq) (+9647729244980).
[2] Alaa Muhsun Yasir, assistant prof(PH,D), University of Baghdad, College of physical Education and Sport Sciences, (alaa.yasser@cope.uobaghdad.edu.iq) (+9647707992708)

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Introduction

Specialists and researchers in the field of sports put great attention to solving the problems facing this field and trying to promote it on the other side, by searching for the most appropriate ways to obtain high achievement through the mechanism of scientifically controlling the components of the load (intensity, size, comfort) ,(Sikhe & Yasir, 2020) And used of scientific theories and the concepts of training science as well as various other sciences, the training process must be fruitful and enhance its results through the use of modern science and modern technologies,(Idrees, Yasir, & Hammood, 2022) and keep pace with development, as it calls for the search for new solutions and innovative means that help push progress forward by finding alternative means more useful than the traditional means used in training in order to develop physical abilities, which are carried out through organized physical preparation and linked to the dynamics of other sciences, so it is considered Athletics activities are events that are affected by physical abilities, especially short distance running events (100-200-400) meters, Achievement is determined by the physical characteristics of the player as well as the kinematic specifications and their association with physical variables (Zahid, 2009).

Many studies have been conducted dealing with training in the aquatic medium, including a study (Kamalakkannan et al., 2010), where the study aimed to identify the impact of water training on the variables of physical fitness selected among volleyball players, and the study was conducted on a sample of (30) players divided into two groups each group (15) players,(Idrees, Yasir, & Rashied, 2022) and the study included the approach (experimental) where the curriculum included (12) weeks, By (3) units per week, for 45 minutes, and the results proved that there are differences between the two groups, and the hydropyometric training group showed a significant improvement in speed, explosive ability and endurance compared to the traditional group.

As for the study (Kumarasamy, 2013), the study aimed to identify the effect of water plyometric exercises on the selected fitness components, and the sample consisted of (30) handball players from different colleges of Tamil Nadu, India, and included the study of the (experimental) methodology, where the program lasted (8) weeks by three units per week, where each unit took (45) minutes, The results proved that there are significant differences between the two groups and in favor of water training, and the hydroponic plyometric training group showed a significant improvement in speed and muscle strength compared to the control group.(Yasir et al., 2020)

As for the study (Taresh, 2020) (water training with resistances and its impact on the development of some special abilities, functional variables and achievement for elite 200-meter runners under 20 years old), the study aimed to prepare exercises in a water medium according to the resistances and to know their impact on some special abilities and functional variables for elite 200-meter runners under (20 years), and the study sample consisted of (8) players from the elite runners of the Baghdad governorate team for the effectiveness of 200 meters under (20 years).(Mondher et al., 2023) It included the curriculum (experimental), where the curriculum included (24) training units distributed over (8) weeks at a rate of (3) and training limit per week, and the most important results of the study showed that training in the water medium with resistors

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had a significant impact on the adaptations in the development of physical and functional variables and the research sample.(Nashwan & Alzoubi, 2022)

As for the study (Bajbouj & Tawashi, 2018), where the study aimed to identify the effect of using plyometric exercises in water on improving the level of achievement, the research sample consisted of (12) players from the Hama University team, and the (experimental) approach was used, as the program included (12) training units distributed over (6) weeks at a rate of two units per week, and the most important conclusions were reached that water plyometric exercises had a positive impact on improving the level of achievement.(Nashwan, 2024)

As for the study (Taresh, 2020) (water training with resistances and its impact on the The study (Al-Fadhli and Hussein, 2012) aimed to prepare exercises for special physical abilities in the aquatic environment (Plyometric), and to identify the effects of these exercises on the development of some types of special strength, speed, starting speed and achievement of the youth high jumpers, and the study sample consisted of Baghdad clubs players (12) players participating in the tournaments held by the Iraqi Athletics Federation for the year (2011), and the study included the curriculum (experimental) where the training program was applied for 8 weeks, Including (16) training units by (2) training units per week, and the results proved that water exercises affected the development of speed, and that the prepared program, which included water exercises as an aid practiced by the experimental group, has contributed to the development of achievement jump.(Alhasan & Rasheed, 2022)

Through the presentation of previous studies, we note that the hindering force index is not used in the regulation of training stress and the lack of use of rapid strength training in the middle and in accordance with the mechanical work done in the least unit of time necessary for these events, which works to develop muscular ability during motor performance through the performance itself or work similar to performance in the race or competition, (EBBEN, 2007).(Ahmed Muhammad AbdulkhaliqAlhasan, 2024)

The problem of the research lies in the absence of some of the foundations on which the development of strength and speed in its training in terms of traditional training methods and methods and the use of traditional and unstudied auxiliary tools and deficiencies in the use of biomechanical analysis in detecting the weaknesses and strengths of runners from the biomechanical side and the lack of deep understanding of the strength of the working muscles and assistance led to a decline and stability of achievement among the members of the study sample, The study aimed to prepare rapid strength training in a aquatic environment according to the index of the obstructive force for runners (100) m free and to identify the values of some kinematic variables, for the starting and completion phase of the research sample and to identify the effect of rapid strength training in a aquatic environment in the development of some kinematic variables for the starting stage and the completion of running (100) m free between the test (pre-post) for the research sample.

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Method and tools:

The researchers used the experimental approach by designing the two equivalent groups with a pre- and post-test to suit the nature of the research problem, "The experimental approach represents the most honest approach to solving many scientific problems in a practical and theoretical manner" (Allawi and Rateb, 1999), and here the researchers identified the research community with the arena and field runners for the 100-meter event in Maysan Governorate over the age of 20 years for the 2023-2024 sports season, which numbered (8), They will be taken fully in a comprehensive inventory manner, as the researchers divided them into two groups by (4) runners for the group that trains rapid strength training in a aquatic environment according to the hindering force index and (4) runners for the group that trains rapid strength training by weighting in the ground center and the process of distributing them in a random way, by lottery method and they represented 100% of the research community.

The researchers used cameras number (4) with their supports at a speed (120 images / second) type (Sony) Japanese, a special regular running field with an effectiveness of 100 m, kinetic analysis software (Kinovea), in order to extract the kinematic variables of the starting stage, where the following variables were extracted:

A - Starting stage: - It was analyzed from the moment of take off until the first step and included the following: -

1- The knee angle of the front leg at the moment of take off

It is the angle between the anterior leg thigh line above the starting cube (from the hip point to the knee joint) and the leg line (from the knee joint point to the ankle joint point) and is measured from the inside because it is a closed angle.

2- The knee angle of the back leg at the moment of :

It is the angle between the thigh line of the posterior leg above the starting cube (from the hip point to the knee joint point) and the leg line (from the point of the knee joint to the ankle joint point) and is measured from the inside because it is a closed angle

3- Angle of the Torso joint:

It is the angle between the Torso line (from the point of the shoulder joint to the point of the hip joint) and the thigh line (from the hip joint to the point of the knee joint). It was measured at the moment of extending the front leg and leaving the kickstand.

4- The angle of the elbow joint of the front arm:

It is the angle between the elbow line (from the wrist joint point to the elbow joint point) and the humerus line (from the elbow joint point to the shoulder joint point) of the anterior arm and is measured from the inside because it is a closed angle.

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5- The angle of the elbow joint of the rear arm:

It is the angle between the elbow line (from the wrist joint point to the elbow joint) and the humerus line (from the elbow joint point to the shoulder joint point) of the posterior arm and is measured from the inside only because it is a closed angle.

6- Push angle:

It is the angle between the line connecting from the point of contact of the foot with the ground to the point of center of mass of the body with the horizontal line and is measured from the front, as it was measured the moment the front leg left the starting cube.

7- Response time: It is the sum of the reaction time and the time of movement and is measured from the moment of the appearance of the stimulus to the end of the motor duty of the starting stage.

Physical tests used:

100m Sitting Test (IAAF ،2019)

1- Objective of the test/

Measurement of running achievement (100) meters.

2- Tools used /

A- A running field with a distance of 100 meters in accordance with legal requirements.

B- Three stopwatch hours (for the two clocks) or the (photo finish) device

C- Starting pistol (sound of shooting).

3- Performance method /

The test begins immediately after the completion of the warm-up process by instructing the laboratory, on the starting line, where the laboratory takes the seated start position after which the shooter gives the starting signal, and at this moment the timers turn on the stopwatches, and when the laboratory reaches the finish line, the stopwatches are stopped.

4- Measurement method / recorded to the nearest 01.0 of the second through (3) three hours of timing, the medium or the possibility of using the photo finch device is taken and the timing is electric.

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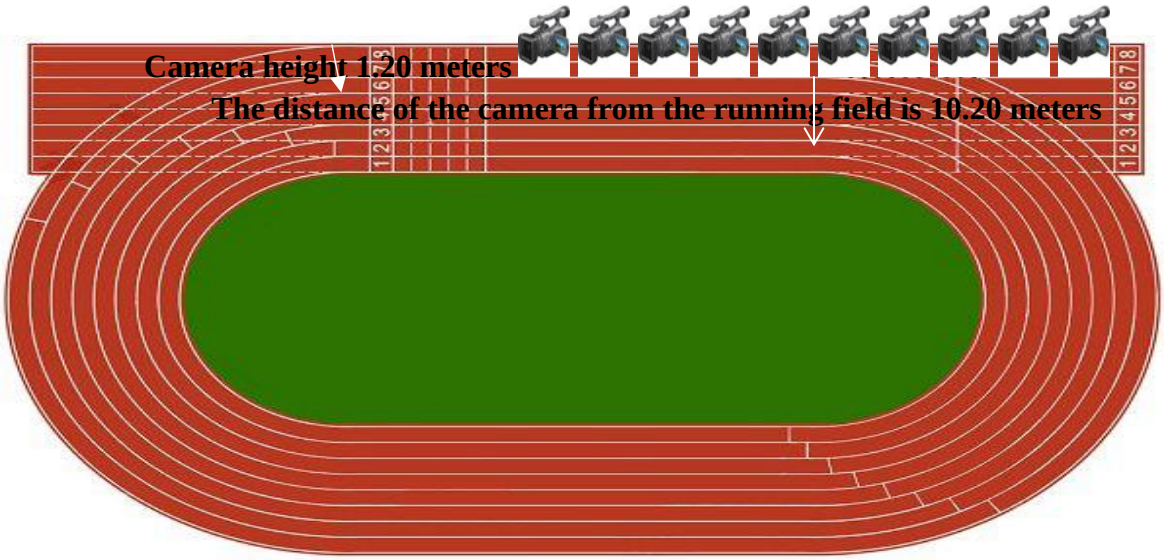

Figure (3-1)
Demonstrates how to place cameras perpendicular to the field of running in video photography and achievement test running 100 meters

The researchers conducted the first exploratory experiment on Sunday, 28/5/2023 at three o'clock in the evening on a sample consisting of (2) from within the members of the research sample, at Maysan Olympic Stadium, and the goal of the first exploratory experiment will be to achieve the following: identifying the number of cameras that will be used in photography, determining the appropriate distance for each camera, checking memory cards (RAM) for each camera with speed control at a rate of 120 frames per second, Ensure the validity of the stadium, the tools and devices used, and the research supplies, know the readiness of the research sample to perform the test, organize the assistant work team, identify the time it takes to test, and the researchers conducted the second exploratory experiment for the members of the experimental research sample on Monday (29/5/2023) and on the large Amara swimming pool and Maysan Olympic Stadium**.**

The aim of the second exploratory experiment was to achieve the following: knowing the time required to implement the training units, determining the training stresses according to the law of obstructive force for the group that trains in the aquatic environment, fixing all observations related to the exercises prepared and the extent of their benefit, identifying the necessary number of auxiliary cadres, which the researcher needs when carrying out the tests and the main experiment, identifying the possibility of the sample on the application of the exercises, And how to deal with the means.

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After conducting the exploratory experiments, the researchers conducted the pre-tests on the research sample on Wednesday (31/5/2023) at Maysan Olympic Stadium, by installing the locations of the cameras, marking them with function points and determining the locations of the signs to facilitate the process of installing the cameras, then the tribal tests were conducted (achievement for the effectiveness of running 100 meters, and video photography) in the afternoon, after the pre-tests, parity was made for the extracted variables as shown in Table (3-2)

(2-3)table
Shows the equivalence of the sample members in the variables of the starting and completion stage

Differences	Sig	Calculated value (T)	Aquatic medium group		Unit of measurement	Variables	Sequencing
			Standard deviation	Arithmetic mean			
Immoral	0.585	0.576	1.660	94.825	degree	Front leg knee angle	1
Immoral	0.801	0.264	0.574	157.660	degree	Leg back knee angle	
Immoral	0.344	1.026	0.420	42.650	degree	Torso angle	
Immoral	0.886	0.149	0.816	92.000	degree	Elbow angle of the front arm	
Immoral	0.453	0.801	1.539	162.175	degree	Elbow angle of the rear arm	
Immoral	0.387	0.933	0.012	1.225	degree	Push angle	
Immoral	0.549	0.635	0.017	10.887	Second	Achievement	

After conducting the pre-tests, the researchers prepared exercises commensurate with the stages of the technical performance of the event and to suit the capabilities of the members of the research sample to reach the best results, as the following was applied: -

Preparation of rapid strength training according to the aquatic environment, the number of weeks is 12 weeks, the number of training units is 2 units per week, the total training units are 24 units, the exercises were applied in the main section of the training unit, the training stresses used in the

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training ranged from 90% - 100%, the application of the exercises was in the period of special preparation, taking into account the exchange of work between muscle groups, planning exercises during the training units 1:2.

• The intensity of the exercises used according to the obstructive force index for the group using the aqueous medium was regulated by the following equations:

Obstructive force: It is the force that occurs by the dynamic effect of the inhibitor that affects the direction of the streaming current of the fluid flow, generally it is a resistance force that slows down the force of movement of the body through the fluid. (Hal, 1995)

$$F_d = c_d \, 1/2 \, \rho \, v^2 \, A$$

(Obstructive force = density of the medium × the obstacle constant × the square of the velocity × the body plane ÷ 2)

For speed = $2\sqrt{}$ × the force of the disability ÷ the flat body × the thickness of the medium × the constant of the disability

Time = m2 × $\sqrt{}$ flat body × thick medium × disability constant ÷ 2 × disability strength

The training method (recursive) was used, and breaks were used between repetitions ranging from (1-3) d, and groups ranging between (2-6) d, and this was confirmed by (Mcfariane, 2009) as it was mentioned that the rest period is (1-3) minutes between repetitions, and (2-6) minutes between groups to train strength and speed in short runs, the exercises were started on Sunday (4/6/2023).

The post-tests were conducted on (Saturday) (26/8/2023) at Maysan Olympic Stadium, and the same conditions in which the pre-tests were conducted will be taken into account, and the researchers used the statistical bag (spss) to process the data.

Results

Table (1) shows the values of the arithmetic mean, standard deviation, calculated value (T) and level of significance for the variables of the starting stage of the group of water mean and achievement

Differences	Sig	Calculated value (T)	Post-Test		Pre-test		Unit of measurement	Variables
			Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean		
Moral	0.002	9.589	1.611	95.067	1.660	94.825	Degree	Front leg knee angle

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Moral	0.030	3.892	0.513	157.915	0.574	157.660	Degree	Leg back knee angle
Moral	0.002	10.830	0.436	42.752	0.420	42.650	Degree	Torso angle
Moral	0.026	4.124	0.847	92.176	0.816	92.000	Degree	Elbow angle of the front arm
Moral	0.008	6.332	1.541	162.070	1.539	162.175	Degree	Elbow angle of the rear arm
Moral	0.031	3.852	0.140	42.195	0.228	42.375	Degree	Push angle
Moral	0.001	11.439	0.012	10.852	0.017	10.887	Second	Achievement
Significant at a significance level less than (0.05)								

Discussion:

The results in Table (1) showed that there are significant differences between the pre- and post-measurements in the variable (knee angle of the front leg, knee angle of the back leg, torso angle, front arm angle, back arm angle,(Kazim et al., 2019) push and achievement angle), and the researchers attribute the significant difference in the results between the pre- and post-tests to the effect of the exercises used, in the aquatic environment according to the hindering force index as a result of the exercises of the aquatic environment, The training program, which includes a set of weight training for the legs, arms and torso, in addition to practicing water training as a suspense factor with the implementation of weight training with intensity appropriate to the research sample, shows positive results (Idrees, Yasir, & Hammood, 2022), And that the legalization of stress according to the index of obstructive force has a doller important in the development of variables researched because through the equation of the obstructive force was to know the degree of disability for each player in the water medium and then was legalized stress according to this obstructive force, as the resistance of water leads to an increase in muscle strength where the researchers believe that the development of muscular strength and speed any development of physical capabilities is reflected in the biomechanical variables, Khudair (2017, p. 80) states that action against water resistance develops strength further through aqueous environment exercises, especially special strength training, which are reflected in the bio kinematic aspects.

The researchers believe that continuing to give information about the ideal technique for performance has a role in improving technical performance, when hearing the start signal must be done and direct the performance of the movement quickly and speed depends here on the

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individual physical, physical and psychological qualities of the runner and play a strong leg a major role in the strong push as a result of the man staying fixed for a longer period, which thus greatly affects the payment at the beginning of the acceleration stage, and that the low position helps to increase the momentum as the horizontal force It is greater than the vertical force compared to the high position, and mentions (Omar and Abdel Rahman, 2018, page 239) "The runner exerts more energy and achieves greater speed, meaning that the energy exerted is large and the player achieves speed and acceleration of this energy."

Therefore, we see the runner's rush quickly forward at an angle of (42 º - 45 º) and the back foot of the back rest is left before the leg in the front rest and the front thigh is in a state of fixed muscular work and a very slight change occurs in the angle of the knee joint, and the actual change begins in the angle of the knee when the knee of the back leg exceeds the knee of the front leg, and the movement of the rush continues until reaching the full extension of the front leg, At this moment the body is in a form almost perpendicular to the ground, and at the end of the starting phase the thigh and trunk are in line with the ground. (Omar and Abdulrahman, 2018, p. 241)

The runner also performs a series of high harmonic movements between the arms and legs together,(Abdulhussein et al., 2024) as he performs a high reaction movement of pushing and pressing with maximum force with the legs against the starting cube and for both feet using the maximum force of contraction of the muscles of the legs in order to leave the back leg foot of the back cube first and then followed by the front leg with full extension of the leg during this push movement while the torso tilts forward and extends the hip joint and coincides with the movement of push A strong weighted movement opposite and effective in both arms from the shoulder joints In order to increase the momentum of the required starting movement and synchronized the movement of pushing the two legs to perform the launch with the best technique and with the maximum force and in the shortest possible time,(Mahmood & Kadhim, 2023) as this works to achieve the correct mechanical manifestations of the angles of performance at the moment of preparation that works to create good conditions to retain the momentum of the body, which contributes to the lowest moment of resistance to gravity (weight torque) as these indicators are associated with achieving good ranges of the angles of the joints of the body. (Idrees, Yasir, & Rashied, 2022), It is necessary to note here that the movement of the arms is from the shoulder joint with flexion in the elbow joint,(Mousa & Kadhim, 2023) as this movement is of great importance in sprint races by contributing to the stability of the body position and helping to develop the technical stages of the race and maintaining the longest possible period of time for maximum speed, as it mentions (Farag, 2018, page 418) quoting ((Latif Thomas) "The arms play an important and moral role in short-distance running and speed development, Without the mechanism of full arm movements, their specificity and regularity, the maximum speed efforts will not be real."

The results also showed significant differences in the achievement variable, as the researchers attribute this improvement to the logical result of the implementation of the exercises prepared according to the hindering force index,(Salih et al., 2024) as the work focused on the implementation according to the scientific foundations in sports training, in terms of determining the training stresses and the nature of performance, repetitions and rest periods, which aimed to

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develop important kinematic variables in the starting stage,(Kadhim, 2024b) which have an effective role in the technique of running and the production of rapid successive movements that lead in the result of obtaining a better achievement. During the running distance, which affected the length of the step and the frequency of the step relatively contributed to the best achievement in running the 100-meter freestyle, as it was mentioned (Al-Sukkari, 1996) that "the use of the appropriate training method is more effective in achieving the training objective used." The researchers believe that these differences are a natural outcome of all that has been mentioned in the results and discussions prior to the starting stage,(Kadhim, 2024a) as the achievement in the competitions of running short distances in general and the effectiveness of 100 meters in particular depend on the kinematic variables of the runner for this any improvement in these variables under study will lead to an improvement in the level of achievement and this is what has been reached and proven by the results in the post-tests, As the application of rapid strength exercises in the aquatic medium according to the indicator of obstructive force,(Kadhim et al., 2021) contributed significantly and effectively to achieving this improvement of the kinematic variables, which in turn reflected on the achievement of runners,(Kazar & Kazim, 2020) and that the good link between the start and start stage contributed to the development of achievement , (Ali, 2005) mentions that the development that accompanied the variables gave an indication of increasing the efficiency and coordination of work between the joints of the body and the working muscles and thus an increase in the achievement achieved, in addition to that the legalization of stress in the water medium was according to the indicator of the obstructive force,(Easa et al., 2022) as the use of this indicator depends on the mass of the player and his surface area and the density of water in addition to the disability and distance traveled and the time achieved in determining the intensity and thus gives more effective and accurate results in the training process, especially when training Speed, through which individual differences between runners are taken into account, and it is mentioned (Al-Fadhli, Lafta, and Hassoun, 2020) that one of the methods of training speed is accuracy in determining intensity.(Farhan et al., 2016)

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module

Date (4/6/2023)-(7/6/2023) • **First week**

Location : Maysan Swimming Pool **First - Second Training Module**
Number of players : 4

Today	Exercises	Intensity	Performance time	Number		Comfort		Working time	Rest time
				Iteration	Totals	Between repetitions	Between totals		
Saturday	Run a distance of (10) meters (water) at neck level Run a distance of (10) meters (water) at chest level	%90	7.49 sec 5.48 sec	3 4	2 2	2- 1.5	3-5 min	44.94 sec 43.48 sec	14.28 min 13.42 min
Tuesday	Partridge with the left leg for a distance of (10) meters (water) at chest level Partridge for a distance of (15) meters with both legs (water) at chest level	%90	7.60 sec 9.38 sec	3 3	2 2	2-1.5	3-5 min	45.60 sec 28.14 sec	14.28 min 10.28 min

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