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The Effect of Using a Device That Changes the Starting Angle in Swimming on Some Kinematic Variables of The Starting Stage of Swimming and The Completion of the 50-Meter Freestyle Swim for The National Team Swimmers (13-15) Years Old

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ABSTRACT

Background: The purpose of this paper is to identify the values of some biomechanical variables for the starting phase, swimming, and completion of the 50-meter freestyle swimming, and identify the effect of using a device (the launch angle changer for the starting stage of swimming) on some of the biomechanical variables affecting the starting stage of 50m freestyle swimming.

Methods: The researcher used the experimental approach using the experimental design method (pre and post-test for one group) due to its suitability to the nature of the research problem. The selection of the research sample came within the basic and important points in the research procedures, which the researcher adopts to reach results with high credibility. Therefore, the researcher chose six swimmers representing (100%) of the origin community, and they are the players of the Iraqi national team, category (13 - 15) years old in the 50-meter freestyle swimming event.

Results: The change in the kinematic variables of the starting phase showed significant differences, which contributed to the development and increase of the swimmer, is starting speed, and the change in the kinematic variables of the starting stage showed significant differences, which contributed to the development and increase of the horizontal distance achieved. One of the most important recommendations is that: increasing focus on the starting stage of swimming during training and including it within the training units for its effective role in improving the level of achievement, and the use of auxiliary tools and devices that help detect weaknesses and enhance strengths, which facilitate the coach's task in developing swimmers

Keywords: 50-meter freestyle swim, starting angle in swimming.

INTRODUCTION

The sport of swimming relies heavily on the kinetic performance of all parts of the body with high-level compatibility, and that biomechanical variables are among the factors that affect kinetic performance directly, as we can through technical and biomechanical analysis identify the strengths and weaknesses of the swimmers. Thus provide sufficient information for the coach to have a base Sober and accurate information in order to work to strengthen the strengths and work to develop them and avoid the weaknesses and thus the development of the digital achievement of the swimmers[(1)].

As the performance of the movement in harmony between the parts of the body needs to determine the movement of the body according to certain paths of the parts of the body and certain angles of the joints of the body and specific times in addition to several other variables, as many methods have appeared, including measuring devices and programs that help in changing and modifying the biomechanical variables to deliver them to the ideal image in a way that suits With the swimmer and his specifications in order to raise the level of technical performance and thus raise the level of achievement([2]).

As for the 50-meter freestyle swimming event, the starting stage is the main key to the start of this event, which gives it great importance in reducing the completion time, due to the increased importance of the starting stage in short distances, since the time required to complete it constitutes a greater percentage of the completion time. So this necessitated the focus of specialists, the coaches and swimmers on this stage to determine the ideal performance for it, because it helps the swimmer to achieve a greater horizontal distance and in an ideal time after pushing off from the platform.

Thus increasing the horizontal distance that the swimmer travels during his flight and the next stage during his entry into the water and the movements of the dolphin that help him to cover the distance after entering until he gets out of the water and starts swimming as quickly as possible [(1)].

Likewise, with regard to the swimming stage after the flow, the appropriate strategy that the swimmer follows to regulate his speed in the race is his ability to invest his energy in the maximum way and benefit from the physical characteristics that the swimmer possesses, especially (the length of the swimmer), so that he employs his capabilities in a way that suits the ideal performance to cover the required distance in the least possible time[(4)].

The importance and idea of the research were summarized by studying the technical stages of the 50-meter freestyle race (starting, flowing, swimming and finishing) and determining the best methods and the most appropriate auxiliary tools that would help swimmers in

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determine the ideal performance for each of these technical stages, which ensures the development of performance for swimmers to improve the level Achievement of the event (50 m freestyle) [5].

Research problem:

Through the work of the researcher in the field of swimming sport as a player and coach, he noticed some weaknesses in the technical stages of the performance of the swimmers during the 50 m freestyle event, which were summarized in the poor performance of the swimmers in the starting stage and the failure to direct the movement properly. So that the swimmer travels the maximum horizontal distance during his flight, as well as not controlling the variables of the length of the stroke and the rate of stroke repetition and delivering it to the ideal shape suitable for the swimmers and according to the individual differences between them. Given the difficulty of directing the swimmers during the performance in the water and the inability of the coach to give them accurate instructions during their performance as well as his lack of control over the speed and rhythm of the performance and the lack of aids that facilitate the process of adjusting the rhythm. On a certain performance, this necessitated the necessity of using some modern means that allow trainers to control these variables and develop appropriate ways to address them swimmers aged 13-15 years to consider the stages of the 50-meter freestyle race and to identify their weaknesses in performance early, especially those affecting the performance. The starting stage as well as the speed of performance during swimming and its treatment through the use of some auxiliary tools that will affect the performance of swimmers in order to identify its impact and work to address the weaknesses that are identified through the biomechanical analysis of the performance of swimmers.

Research objective:

- Identifying the values of some biomechanical variables for the starting phase, swimming, and completion of the 50-meter freestyle swimming.
- Identifying the effect of using a device (the launch angle changer for the starting stage of swimming) on some of the biomechanical variables affecting the starting stage of 50m freestyle swimming.

Research hypotheses:

- There are statistically significant differences in some of the biomechanical variables affecting the starting phase of the 50-meter freestyle swimming between the pre and post-tests as a result of using a device (the starting angle changer for the starting phase of swimming).

Research fields:

- Human field: National team swimmers (13-15 years old)
- Time field: (20/4/2022) to (28/6/2022)
- Spatial field: Indoor Olympic Al-Shaab Swimming Pool.
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METHODOLOGY

The researcher used the experimental design method (pre and post-test for one group) due to its suitability to the nature of the research problem.

Community and sample research:

The selection of the research sample came within the basic and important points in the research procedures, which the researcher adopts to reach results with high credibility. Therefore, the researcher chose a sample consisting of (6) swimmers representing (100%) of the origin community, and they are the players of the Iraqi national team, category (13 - 15) years old in the 50-meter freestyle swimming event. 6 is very low

Ethical consent: No patients in the study

Informed consent was taken from the patient's relatives or the patient himself when he was still conscious with keeping the patients` records confidential in all stages of the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Data collection methods:

It is a set of means used by the researcher to solve the problem of his research (devices, tools, work team, personal interviews....etc.).

Means of collecting information:

- Arabic and foreign sources.
- Personal interviews.
- International Information Network (Internet).
- Observation and analysis.
- Software and applications used in the computer:
- (Kinovea) program for kinetic analysis.
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Equipment and tools used in the research:

- A device that changes the starting angle of swimming.
- (1) HP laptop computer.
- (3) Casio fast cameras with a frequency of 120 images/second.
- (1) Casio water camera, with a frequency of 25 images/second.
- A tripod for the camera, number (3).
- A tape measure of 50 m.

- Olympic swimming pool 50 m closed.
- Whistle number (1).
- Timing hours (3).
- Scale drawing length (1 m).
- A measuring tape of length (3 m) to calculate the body measurements of swimmers.
- 14- A stick holding the camera.
- 15- The auxiliary work team.

Swimming start angle changer device and how it works: It is a training device that determines the performance path for the starting stage of the swimmer, as the idea of the device works is summarized in that the laser beams attached to the device are directed directly at the optical sensor, and in this case, the device does not emit any sound or light signal, but if any dark object passes In front of the laser beams and blocking them from the optical sensor, this will lead to the issuance of an audio signal and a light signal to warn of the occurrence of a break in the delivery of the laser beams to the optical sensor, as the laser beam line is in the form of a horizontal barrier in front of the swimmer, as the swimmer must pass it from the top of the flight stage, and if failing to pass the laser barrier, the device will emit two audio and optical signals from the control box as a result of the swimmer's body cutting the laser beam line, causing the laser beams to be blocked from the optical sensor. The distance of the laser line from the swimmer can be adjusted by moving the two cubic tubes connected to them by the optical sensor and the laser beam source evenly and determining After them from the measuring tape installed on them, in addition to that, the angle of the device can be adjusted by using the manual lever to change the direction of the two cubic tubes, and the angle of inclination of the two cubic tubes is determined of the pointer on the inserted circuit installed on the base of the device as show in the figure (1).

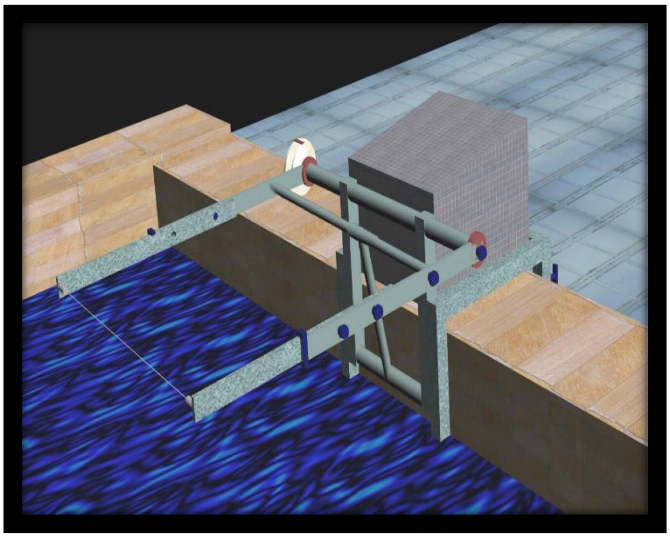

Fig. (1) Shows the start angle changer device

Exploratory experiences:

First exploratory experiment:

The researcher conducted the exploratory experiment, as the starting stage was filmed for swimmers representing the Iraqi national swimming team on (Wednesday) corresponding to 4/20/2022. The moment of the swimmer's launch (at the last touch with the starting platform), supports the research problem and the design of a device for the purpose of improving the starting angle and bringing it closer to the optimal angle.

Second exploratory experiment:

For the purpose of determining the accuracy and validity of the work of the research, and for the purpose of avoiding obstacles that may appear in conducting the main experiment, the researcher conducted the second exploratory experiment on (Thursday) corresponding to 4/28/2022 at (5:00 pm) at the closed Olympic People's Pool, and the sample included swimmers From the research sample and the experiment procedures will be very similar to the procedures of the main experiment, as a device that changes the starting angle will be used to swim in it, and the aim is to identify the accuracy of the device's work and the extent of its validity, as well as to ensure the availability of the safety factor for swimmers, as some obstacles have been identified in the work of the device to be avoided in the main experimental procedures.

Field experiment procedures

Pre-test

The pre-test was conducted for the sample at (9 am) on (Monday) corresponding to 5/2/2022, for the purpose of filming and analyzing their performance to calculate the values of the biomechanical variables that affect the starting stage in swimming 50m freestyle as each swimmer performs the starting stage from the platform and is photographed from the preparation position until the moment he exits the water after the flow stage and performs the strokes of the arms and legs during swimming the remaining distance, in addition to calculating the time of the first 15m and the time of completion for the 50m freestyle swim.

Videography:

The photography included all stages of the performance of the starting stage represented by the first 15 m, which is divided into the preparation stage, the launch stage, the flight stage, the water entry stage, and the flow stage until the swimmer exits the water after the flow stage, and the kinetic performance of the arms and legs during swimming the remaining 50 m freestyle distance the camera (1), which was at a speed of (120 images/sec), was placed on the right side of the pool, as it is (1.50 m) away from the near edge of the pool and (8.10 m) away from the swimmer. It was placed on a

tripod with a height of (0.90 m) and perpendicular to field No. (3) for the swimming pool, while the camera (2) was placed on a tripod at a height of (0.30 m) above the surface of the water, and a distance of (2.60 m) from the starting edge, camera (3) was placed, which was at a speed of (25 images/sec) and a distance of (5.50 m) below the surface of the water at a depth of (0.40 m), as it was held by the stick carrying the camera, and both of them were far from field No. (3), which the swimmer will swim in it at a distance of (6.10 m), and it is at a distance of (2.60 m) from the beginning of the nearby swimming pool, as for camera No. (4), it was installed on a tripod with a height of (1 m) on the right side of the pool, at a distance of (9.20 m) from the swimmer, so that the remaining distance appears until the swimmer exits, and a distance of 35 m divided into three areas will be photographed from the right side (3) cameras from the swimming pool, as camera (5) will be placed to film a distance of (10 m) after the first full 15 m, camera (6) to film a distance of (10 m), and camera (7) to film another (15 m), and cameras will be (5) and (6) On a tripod with a height of (1.20 m) at a distance of (10 m) from field No. (3), and the camera (7) will be on a tripod with a height of (1.30 m) at a distance of (11.5 m) from the field (3)

Three referees accredited by the Iraqi Swimming and Water Sports Federation calculated the performance time for (50 m) freestyle swimming.

The first referee gave the starting signal to each swimmer, and after the swimmer started, the total completion time for the distance was calculated from the average time of 3 hours of stopping the referees.

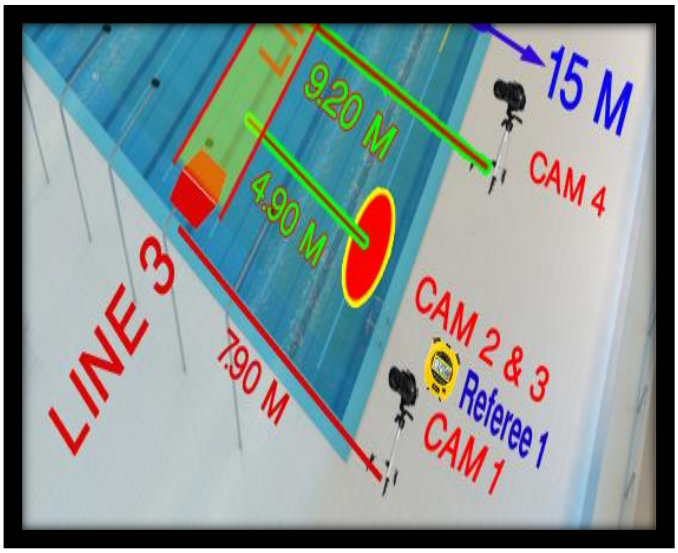

Fig.2 shows the locations of the cameras and the filming procedures for the pre-test, along with the referees' parking spots.

Biomechanical variables for research:

1- Launch speed: It is measured from camera imaging (1) and the distance is determined between two points of the body's center of gravity, the first (the moment of the last touch of the toes with the starting platform) and the second (after the swimmer's body left the platform), i.e. after (7 photos) from the moment of the last touch with the platform Also, the time of travelling this distance between these two points is calculated, and from the distance and time, the amount of starting speed is extracted as shown in Figure (2).

2- The angle of departure: it is the angle confined between the horizontal line with the line connecting two points of the body's center of gravity, the first (the moment of the last touch of the toes with the starting platform) and the second (after the swimmer's body left the platform), that is, after (7 photos) from the moment of the last touch with the platform It is measured from the front. In addition, its calculation from camera photography (1) and Figure (3) shows the method of measuring the departure angle.

3- Flight time: It is the time taken by the swimmer during his flight in the air after the launch phase, and it is calculated from camera photography (2)

4- The horizontal flight distance: It is the distance between the edge of the swimming pool and the place where the swimmer's hand enters the water and calculated from camera imaging (1) as in figure (2).

5- Total completion time for 50-meter freestyle swimming.

Main experiment procedures

The researcher used a device that changes the starting angle in swimming as an aid to improve the starting angle and bring it closer to the optimal angle, at which the maximum horizontal flight distance is achieved in an optimal time, as the device was introduced as an aid within the training units of the group the training on the device is under the supervision of the trainer.

A device that changes the starting angle of swimming was used in the training units in the form of five stages, the length of the device increases by (5 cm), according to the sample passing the laser beam line attached to the device. In each stage, after the sample passes the specified distance, the angle of the device is raised by a certain amount and according to the trainer as shown in the following table.

Table (1) shows the each stage, after the sample passes the specified distance, the angle of the device is raised by a certain amount and according to the trainer

Stages	After the laser beams from the starting edge	Angel	number of training units	Number of swimmers passing the stage
First	1.65 meter	0 degree	1	6
	1.65 meter	3 degree	1	6
	1.65 meter	5 degree	1	6
	1.65 meter	10 degree	1	6
Second	1.70 meter	0 degree	1	6
	1.70 meter	3 degree	1	6
	1.70 meter	5 degree	1	6
	1.70 meter	8 degree	1	6
Third	1.75 meter	0 degree	1	6
	1.75 meter	4 degree	1	6
	1.75 meter	6 degree	2	6
Fourth	1.80 meter	0 degree	1	6
	1.80 meter	2 degree	2	5
	1.80 meter	5 degree	3	3
Five	1.85 meter	0 degree	2	2
	1.85 meter	3 degree	2	0
	1.85 meter	0 degree	2	3

The researcher followed up the development of the research sample in the training units, from photography and analysis, as photography began from the second stage until the subsequent stages, and one camera was used, placed at a distance of (1.50 m) from the starting platform and at a distance of (11.5 m) from the swimmer.

Post-test:

After the group finished the training units in which the device was used, the post-test was conducted on the group on (Saturday) corresponding to 6/25/2022, as the researcher was keen to complete the post-test in conditions similar to the conditions of the pre-test.

Statistical methods

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

RESULTS

Presentation, analysis and discussion of results

According to the determinants of verifying the hypotheses of the research, the researcher presents the treatment of the results of the pre and post tests to measure the biomechanical variables for the starting and completion stages, and then their relationship to the achievement of swimming (50) meters freestyle in tables and charts, and then analyzing the values contained therein to discuss and support them with the scientific sources. As follows:

Presentation of the values of the acceleration variable and the variables (start speed - start angle - flight time - horizontal flight distance) for the research sample, analysis and discussion.

Table (2) shows the values of the arithmetic mean, standard deviations, the calculated (T) value, the (Sig) score, and the statistical significance of the results of measuring the kinematic variables for the starting phase of the (50) meter swimming before and after for the research sample

Kinematic Variables	Pre-Test		Post-Test		Arithmetic Mean of Difference	Standard Error of The Mean Difference	T Value Calculated	Level Sig	Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation					
Start Speed	4.48	0.04	4.90	0.16	-0.42	0.130	-8.028	0.000	Sig
Start Angle	-13	2.09	-8.33	1.75	4.66	0.516	22.136	0.000	Sig
Flight Time	0.33	0.009	0.36	0.012	-0.03	0.010	-7.706	0.001	Sig
Horizontal Distance	2.93	0.04	2.98	0.04	-0.04	0.006	-19.365	0.000	Sig

Each value in the Sig error ratio field >0.05 is significant with a degree of freedom (5)

Presenting the results of the completion of swimming (50) meters freestyle, before and after, for the research sample, and analyzed and discussed.

Presentation and analysis of the results of the achievement of swimming (50) meters freestyle, before and after, for the research sample:

The following is the treatment of the results of measuring the achievement of swimming (50) meters freestyle, before and after, for the research sample, and then analyzed, as shown in Table (3).

Table (3) shows the values of the arithmetic mean, standard deviations, the calculated (T) value, the (Sig) score, and the statistical significance of the results of the completion of the (50) meter freestyle pre- and post-swimming for the research sample.

Achievement	Pre-test		Post-test		arithmetic mean of difference	standard error of the mean difference	T value calculated	Level Sig	Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation					
Achievement time	28.19	1.33	27.60	1.25	0.598	0.199	7.34	0.001	Sig

Each value in the Sig error ratio field >0.05 is significant with a degree of freedom (5).

DISCUSSION

Analyzing and discussing the results of measuring the kinematic variables of the state of readiness and launch in the starting phase of swimming (50) meters freestyle, before and after, for the research sample:

Through the above table, we noticed the emergence of significant differences between the pre and post-tests of the starting speed variable. (Remove comma,) This change in the amount of the starting speed was primarily due to the increase in the tide of all the joints of the body during the start (the moment of the last touch with the platform). As we mentioned above, which helped in increasing the force on the starting platform, as a large reaction force generated that pushed the swimmer's body forward.

Then as a result of increasing the value of each of the variables of body angles, as well as the variable of the propulsion force, the value of the starting speed variable has increased, which is one of the factors affecting the horizontal flight distance, as the relationship between them is direct, according to the previous law. [2,5,6]. Also, there were significant differences in the departure angle variable between the results of the pre-test and post-test circles. These differences appeared as a result of the use of the proposed device in the main experiment period, which directly affects the departure angle variable of the research sample members from their training to pass the laser barrier. For the device, which would raise the level of the launch angle above the horizon line (the imaginary horizontal line passing through the center of gravity of the body at the moment of launch) in order to approximate it to the optimal angle that achieves the best horizontal flight distance for each swimmer. The height of the body's center of gravity at the moment of take-off, which in turn contributed to increase the value of the relative height of the body's center of gravity, which raised the level of the take-off angle and its approach to the horizontal line, i.e. from the angle (zero) at the moment of take-off.

The angle of departure is directly proportional to the variable horizontal flight distance, and this shows the direct and effective influence to achieve the optimal angle of departure, which is less than (45 degrees) which has a major role in achieving a greater horizontal flight distance [11].

There were also statistically significant differences between the arithmetic mean of the flight time variable for the pre and post-tests, and this occurred as a result of the increase in the value of each of the relative height of the body's center of gravity, as well as the increase in the value of the departure angle, which led to an increase in the horizontal flight distance, as they are directly proportional to the variable of the horizontal flight distance, which led to increase the time spent in the flight phase as a result of covering this distance of swimmers .

Concerning the horizontal flight distance variable, the results showed statistically significant differences between the pre and post-test, as a result of the

development of the three factors affecting the horizontal distance travelled by the projectile (swimmer's body), namely the launch speed and the angle of departure, as the results showed significant differences for these three variables, as we mentioned above [12].

Discussing the results of the achievement of swimming (50) meters freestyle, before and after, for the research sample:

From table (3), we noticed that the differences are statistically significant between the arithmetic mean of the pre and post-test of the variable of completion time for 50 m freestyle swimming and in favor of the post-test. m freestyle and the time of running it is part of the total time required to complete the 50-m freestyle distance, so it is certain that reducing the time of the first 15 m of the race will be reduced from the time of the total completion, that the development that occurred in the time of the first 15 m in all its stages is due to the development of some biomechanical variables as a result of the use of the device The proposal during the training units in the main experiment procedures for the starting performance, which contributed to the reduction of the time required to cover this distance, as the starting time contributes a percentage (10%) of the completion time for swimming 50 m [13,14]. The reason for the apparent differences in the completion time of the 50-m freestyle is due to the change in the variables of stroke length and frequency, which was clearly reflected through the appearance of the difference in the average speed during the distances travelled, which also contributed to the reduction of the total completion time of the 50-m freestyle.

CONCLUSIONS

- The change in the kinematic variables of the starting phase showed significant differences, which contributed to the development and increase of the swimmer, is starting speed.
- The change in the kinematic variables of the starting stage showed significant differences, which contributed to the development and increase of the horizontal distance achieved.
- The departure angles differed between one swimmer and another, and the achieved horizontal flight distance differed according to the individual differences between the swimmers, as each swimmer has his own ideal performance that is consistent with his physical measurements.
- Reducing the time of the starting stage as a result of the changes that occurred in the kinematic variables affecting the starting stage, as these changes contributed to reducing the time of the starting stage, which contributed to improving the completion time of the 50-meter freestyle swim.

RECOMMENDATIONS

Through the conclusions reached by the researcher, he recommends the following:

- Increasing focus on the starting stage of swimming during training and including it within the training units for its effective role in improving the level of achievement.
- The use of auxiliary tools and devices that help detect weaknesses and enhance strengths, which facilitate the coach's task in developing swimmers.
- Increasing the culture and awareness of swimmers by explaining the importance of biomechanical variables in a simple way and the extent of the impact of using angles, distances and appropriate force in the economy of effort in order to create an advanced sports generation to raise the level of sports for the better.
- Conducting similar studies on the rest of the methods (butterfly, back, and chest) to discover errors and correct them.
- Conducting similar studies on other freestyle swimming competitions (100m - 200m - 400m - 800m - 1500m)

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