The relationship between Arm Length and some Bio-Kinematic Variables in (50 M) Butterfly Swimming for Iraqi National Swimmers.

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Abstract

Competitive swimming is a highly researched area and technological developments have aided advances in the understanding of the biomechanical principles that underpin these elements and govern propulsion. Moreover, those working in the sports field especially in swimming are interested in studying, analyzing, evaluating and developing motor skills by diagnosing the strengths and weaknesses of the skill, and accordingly, coaches and specialists correct these errors. The researchers chose this (Butterfly swimming) and the (arm length) is an important variable because the success of the stroke is greatly dependent on the propulsion generated from the arm pull, and swimmers with a longer arm span have a mechanical advantage with the resulting force being greater than those with a shorter arm span are. The descriptive method was used in a comparative manner, and the research sample was chosen intentionally are (3) swimmers from the advanced category in the (50 m) butterfly swimming. This study took one month to filming the swimmers and take (8) kinematic variables were determined, it was identified that there is a significant relationship between the following variables (maximum time for strike, maximum time for arm (recovery phase), total of arm strikes and rate length for Strike). Moreover, the conclusion was Based on the presented data, butterfly swimming performance was depend on (upper limps) in general, the (Arm length) in particular, and .(more on technical variables (mainly motor coordination

Key Words: Bio-kinematics, Butterfly Swimming, upper limp and software system (Kinovea).

العلاقة بين طول الذراع وبعض المتغيرات البايوكينماتيكية في سباحة الفراشة (50 متر) لسباحي المنتخب الوطني.

الملخص

تعد السباحة التنافسية مجالًا تم بحثه بشكل كبير وقد ساعدت التطورات التكنولوجية على التقدم في فهم المبادئ الميكانيكية الحيوية التي تدعم هذه العناصر وتحكم الدفع. كما يهتم العاملون في المجال الرياضي وخاصة السباحة بدراسة وتحليل وتقييم وتطوير المهارات الحركية من خلال تشخيص نقاط القوة والضعف في المهارة، وعليه يقوم المدربون والمتخصصون بتصحيح هذه الأخطاء. اختار الباحثون (سباحة الفراشة) ومتغير (طول الذراع) كمتغير مهم جداً في الدراسة لأن نجاح هذه الضربة يعتمد بشكل كبير على الدفع المتولد من سحب الذراع، ويتمتع السباحون ذوو الذراع الأطول بميزة ميكانيكية حيث تكون القوة الناتجة أكبر من أولئك الذين لديهم ذراع أقصر. تم استخدام المنهج الوصفي بطريقة المقارنة، وتم اختيار عينة البحث عمدياً وهم (3) سباحين من الفئة المتقدمة في سباحة الفراشة (50 م). استغرقت هذه الدراسة شهراً واحداً لتصوير السباحين وتم تحديد (8) متغيرات كينماتيكية، وتبين أن هناك علاقة معنوية بين بعض المتغيرات التالية (أقصى زمن للضربة الواحدة، أقصى زمن للذراع (مرحلة التغطية)، وعدد ضربات الذراعين ومعدل طول الضربة). وتم الاستنتاج بناء على البيانات المقدمة أن أداء سباحة الفراشة اعتمد على (الجزء العلوي) بشكل عام وعلى (طول الذراع) بشكل خاص، وأكثر على المتغيرات الفنية (التنسيق الحركي بشكل أساسي).

الكلمات المفتاحية: البايوكينماتيك، سباحة الفراشة، الطرف العلوي وبرنامج.(Kinovea)

INTRODUCATION

In competitive butterfly swimming, athletes should strive to improve their technique in order to achieve high propulsion force and avoid substantial intra–cycle variation in displacement of the center of mass in cyclic limb and body movements. The swimmer does not move at a constant velocity, because variations in the action of arms, legs and trunk lead to changes in swimming velocity in each strike cycle. These movements are aimed at overcoming inertia and hydrodynamic drag, which enables efficient locomotion (Strzała, M et al., 2017). Those working in the sports field especially in swimming are interested in studying, analyzing, evaluating and developing motor skills by diagnosing the strengths and weaknesses of the skill, and accordingly, coaches and specialists correct these errors. Mechanical conditions are among the most basic factors that play a major role in determining correct performance and detecting errors. Competitive swimming is a highly researched area and technological developments have aided advances in the understanding of the biomechanical principles that underpin these elements and govern propulsion through the water (Sanders, et al., 2006).

Butterfly is the most difficult of the four swimming strokes and is highly complex in its coordination. It is the second fastest stroke to front crawl. The success of the stroke is greatly dependent on the propulsion generated from the arm pull, and swimmers with a longer arm span have a mechanical advantage with the resulting force being greater than those with a shorter arm span are. This may explain why the world's best butterfly swimmers have a greater arm span than backstroke, breaststroke, and individual medley swimmers.

The primary goal of the butterfly arm movement is to produce an effective way of pushing the water backward so that the swimmer can be propelled forward. From the body in lateral motion. This phase creates lift and forward movement but is a highly ineffective way to propel the swimmer. In swimming, generating propulsion depends on a personal hydrodynamic profile (Barbosa et al., 2012, 2014) which could be assessed by analysis of swimmers' drag force (passive and active drag), and mechanical power and their relationships with anthropometrics. Swimming kinematics is associated with anthropometric characteristics in the front crawl as evidenced by the results of studies conducted in youth swimmers (Morais et al., 2012, 2013; Maszczyk et al., 2012). In those and further studies of (Morais et al. 2016), it was shown that a significant relationship existed between the arm span and propelling efficiency or performance in youth swimmers.

The resulting movement of the upper arm and the beginning of the forearm then sweep inwards and back towards the body. It is during this phase where the propulsive force is generated and the direction of force is determined. This is also known as drag propulsion because of the turbulence and separation of flow that is created in the water. The final phase involves the inward and upward movement of the arm and it occurs when the arm has reached the vertical depth position. This is a non-propulsive phase and serves to reposition the arm for recovery.

Propulsion in swimming comes from the combination of propulsive and resistive forces. Propulsive force is the force generated by the hands and feet to pull and push the body through the water in a given direction.

Resistive forces are the forces that prevent the body from moving in the direction desired by the hands or feet. A similar effect was found in the study of (Seifert et al. 2008) where more-skilled butterfly swimmer had greater velocity, stroke length, and stroke rate as well as better synchronization of the arm and leg stroke phases than the less-skilled swimmers.

It is becoming a more popular stroke in both competitive and recreational swimming. Due to the complexity of the stroke, there is a need for swimmers and coaches to understand the stroke mechanics, as well as the stroke dynamics in order to enhance performance. There have been numerous studies on the butterfly stroke, which have included simple kinematic or kinetic analysis or muscle activity studies. These studies have provided valuable information for both swimmers and coaches in understanding the stroke mechanics. However, many have only looked at the effects of manipulation of a single variable, and there has been no study, which has looked at the simultaneous movement for the arms and undulating movement for the body in relation to changes in a single variable. The existing literature on the subject acknowledges the importance of somatic traits such as body length and composition, which must be taken into consideration when analyzing the bodies of swimmers who compete in the butterfly event. (Silva, et al., 2007). Biomechanics plays an important role in giving positive results by improving and developing technical performance (technique) (Muhsen & Abbas, 2022, p. 240).

The aim of the study:

Analyzing the influence of selected upper limps features (Arm Length) on (50 m) butterfly swimming.

Found the relationship between Arm Length and some Bio-Kinematic Variables on (50 m) butterfly swimming.

MATERIALS AND METHODS

Participants

The descriptive method was used in a comparative manner to suit it with the nature of the research problem, and the research sample was chosen intentionally to suit it with the research objectives, The research sample are (3) swimmers from the advanced category in the (50 m) butterfly swimming, out of (4) swimmers, who represent 75% of the original community. The research sample (3 swimmer) for (50 m) butterfly swimming, their ages are under (20) years and the morphological measurements of the sample were as shown in Figure (1) below:

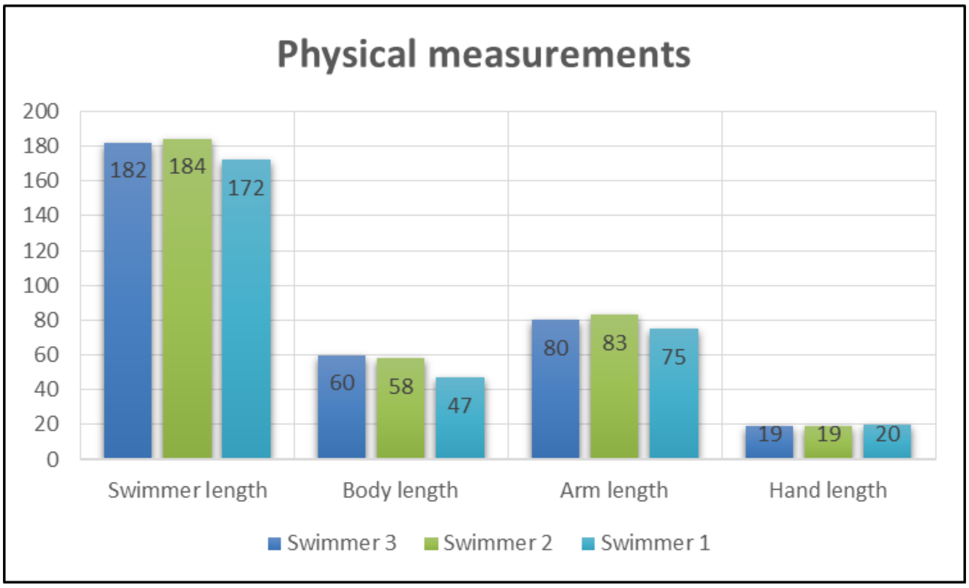

Figure (1): The Physical measurements included (swimmer length, body length, arm length and hand length).

The Specifications of the study sample were as shown in Table (1) below:

Table (1): Minimum and Maximum, arithmetic Means, Standard Deviations, and Skewness for Physical measurements of the Study sample.

Physical measurements	Minimum	Maximum	Mean	Std. Deviation	Skewness
Player length	172	184	179.3	6.42	1.54
Arm length	75	83	79.3	4.04	0.72
Hand length	19	20	19.3	0.57	1.7
Body length	47	60	55	7	1.57

The researchers used sources and references, electronic information network, observation and experimentation, personal interviews, tests and measurements, a measurement of height and weight, a stopwatch, cones, a scale of (1) meter, *Casio* camera (1000 p/s), *Sony* camera (25 p/s), *HP* laptop, A modified cart with a glass basin for placing cameras in the water.

Procedures

The pre-test was conducted on (21/3/2023) in Swimming pool at college of physical education and sport science University of *Baghdad*. We chose one swimmer to swimming for a distance of 50 meters (Butterfly Swimming). the distance of (50 m) swimming was divided into specific (3) sectors to facilitate data monitoring. As the first distance (from the beginning to the mark was a distance of 15 meters). Moreover, the second distance (from the end of 15 meters to the end of the first 30 meters, then the last 5 meters before the end of the race before the wall).

It was aimed to work with high accuracy, avoid obstacles facing in the test, identify the locations and height of the cameras, determine the speed of the cameras used in recording the film, determine the number of the supporting work team, distribute the work tasks of each of them, and finally determine the time it takes to carry out the experiment and perform the test for one swimmer.

Swimming test and kinematic analysis

The Swimming test was conducted on (25/4/2023) in same Swimming pool, in the same procedures that were previously carried out in the pre-test. Colored balloons were used as a mark to divide the race distances into three distances. We used a Sony camera butted on stand (10 m) away and (1 m) high to filming the swimmer. The second distance used a modified cart but inside their two camera (Casio) their speed. (120 p/s) to filming the swimmer, one of these cameras was under the water depth (30 cm) and other over the water height (30 cm). When the swimmer reaches the second distance, the camera starts recording (distance 30 meters). Then using motion analysis software system (Kinovea) to extract kinematic variables from recording, And the kinematic variable are:

- Minimum elbow angle (degree).
- Maximum time for strike (s).
- Maximum time for arm (pull phase) (s).
- Maximum time for arm (recovery phase) (s).
- Total of arm strikes (number).
- Rate length for Strike (meter).
- Arm frequency (number/s).
- Achievement time (s).

Statistical analysis

The researcher to process the data used the (Spss v. 17.10) statistical package.

Results and Discussion

The Results

Table (2): arithmetic Means, Standard Deviations, Person Correlations, significance level of the Kinematic Variables of the research sample.

N	Kinematic Variables	Mean	Std. Deviation	Person Correlations	Sig
1	Minimum elbow angle	108	2.64	0.655	0.646
2	Maximum time for strike	0.96	0.071	0.751*	0.045
3	Maximum time for arm (pull phase)	0.66	0.075	0.297	0.808
4	Maximum time for arm (recovery phase)	0.36	0.022	0.666*	0.053
5	Total of arm strikes	18.66	1.15	0.825*	0.027
6	Rate length for Strike	1.61	0.096	0.929*	0.024
7	Arm Frequency	1.13	0.069	0.335	0.623
8	Achievement time	28.18	0.95	0.399	0.739

*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

The statistical results presented in Table (2) above showed that the results of the kinematics Variables data extracted From analyzing the videos of the three swimmers through the motion analysis software system (Kinovea), The simple correlation coefficient (Pearson) was used to determine if there is a correlation between the Arm length and the kinematic variables selected in this study. There is no significant correlation between Arm length and the Minimum elbow angle because the Sig is (0.646) bigger then (0.05), There is significant correlation between Arm length and the Maximum time for strike and the Sig is (0.045) less then (0.05), The reason why there is significant correlation it's there Positive relationship between the Arm length and this variable's. There is no significant correlation between Arm length and the Maximum time for arm (pull phase) because the Sig is (0.646) bigger then (0.05). The reason why there is no significant correlation was in the (pull phase) the load in this phase is farther then pivot and effort point, It represents a lever of the third type they need from biceps muscle to produce force to overcome resistance.

There is significant correlation between Arm length and the Maximum time for arm (recovery phase) because the Sig is (0.053) equal the sig (0.05). The reason why there is significant correlation was the load arm is less then (pull phase), it represents the first lever type because the arm of effort and arm of load are equal and the fulcrum is in the middle. It was used for to change direction. There is no significant correlation between Arm length and the Maximum Angular velocity for arm (recovery phase) because the Sig is (0.909) bigger then (0.05).

There is significant correlation between Arm length and two variable (Total of arm stroke and Stroke length rate) and there Sig was (0.027) and (0.024) less then sig (0.05). These variables was significant correlation because there was Inverse relationship between the total of arm stroke and arm length, when the arm was longer the total of strikes less, vice versa. Moreover, there a Positive relationship between the stroke length rate and the arm length when the arm was longer the stroke length rate was longer.

There is no significant correlation between Arm length and the Arm frequency because the Sig is (0.623) bigger then (0.05). There is Inverse relationship between frequency and arm length, the law of frequency in swimming is the length of strike in (30 m) divided into the time. There is no significant correlation between Arm length and Achievement time because the Sig is (0.739) bigger then (0.05). The reason why there was no significant correlation between them because the Achievement time does not depended on (upper limps) (arm length) only, but rather all (physical measurement) and kinematic variables are related.

Conclusion

Based on the presented data, butterfly performance may depend on (upper limps) in general, the arm length in particular, and more on technical variables (mainly motor coordination). Therefore, other studies should increase and update knowledge about the relationship between (physical measurement) and butterfly performance, this study emphasizes the importance of selecting swimmers according to physical measurements and their important role in performance.

The results indicate there is a significant relationship with some kinematic variables like (Maximum time for strike, Maximum time for arm (recovery phase), Total of arm strokes and Stroke length rate), and arm length, as well as no correlation with other variables. The researchers confirm on the future studies must use the results of this study for To develop and improve the method of selecting swimmers for the sport of butterfly swimming, and to work on extracting other kinematic variables and their relationship with the physical measurements for swimmer.

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