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Original Research

An analytical study of some biomechanical variables and the achievement level of 2000 m rowing

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Abstract. This study aimed to analyse the first 250 m in rowing (2000 m) racing by finding the relationship between some biomechanical variables and the achievement(time) of the race. The study design was an analytical descriptive method linked to the relationship between variables, with the intention of selected the participants which is represented by 6 of the best achievements players from the Iraqi National Youth Team for rowing, All participants performed the test between 13:00 - 14:00 h afternoons, which is the same weekly training time for participants. The level of the relationship between the biomechanical variables and the achievement was uneven in terms of the strength and weakness of the relationship, however, the research ended in results that can be used as a guide for the training rowing. It very important to focus on the training of special endurance because of it an important factor in this types of racing which require the rower to stay in the same velocity to the end of the race, this can be as a proposed study.

Keywords. Achievement, kinematical variables, rowing.

Introduction

The importance of this research lies in using biomechanical indicators in determining the most important points of strength and weakness in the level of the technical performance during the achievement of 2000 m rowing, the main attraction in rowing is the permanent quest to achieve the optimal combination of force, endurance and coordination. Practical experience illustrates that, of these three factors, coordination is the most challenging for rowers to achieve (Anderson et al., 2005).

The aim of the study was to identify the relationship between the Biomechanical variables during the first 250 m of the race distance and the overall achievement level in 2000 m rowing.

In competitive rowing, it is tactically and psychologically advantageous to gain placement at the front of the race by increasing effort at the start. This will allow the rowers, who look backwards down the course, to be able to monitor the position of other boats and react to any sudden advances from other competitors, and allows them to avoid the wake of other boats. In some sports, there is some evidence that a fast start is the optimal strategy, whereas in other sports a slow start may be beneficial (Garland, 2005).

The rowing biomechanics is quite complex and has not yet been fully investigated (Jones & Miller, 2002), and there is a good corpus of op inions about the effect of biomechanical variables on the achievement in rowing.

Success in the sport of rowing requires a powerful biological system (the rower) and an appropriately designed mechanical system (the shell) that effectively uses the rower's power and minimises drag forces acting on the shell and rower. Identifying rower attributes, shell design characteristics, and rowing motion dynamics that are most effective for maximising sustainable shell speed requires a thorough understanding of the interactions between the biological and mechanical systems (Baudouin & Hawkins, 2002).

The basic principle of rowing is simple momentum that is transferred to the water by pulling on the oar and pushing off with the legs. This results in causing a backward slide of the seat. The oars pivot on "riggers" which lever the water backwards

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(Levine, 2013) and the whole process requires high power production, effective technique, and strong psychology. This makes performance in rowing a complex matter, as is the case in any sport and a smart race strategy.

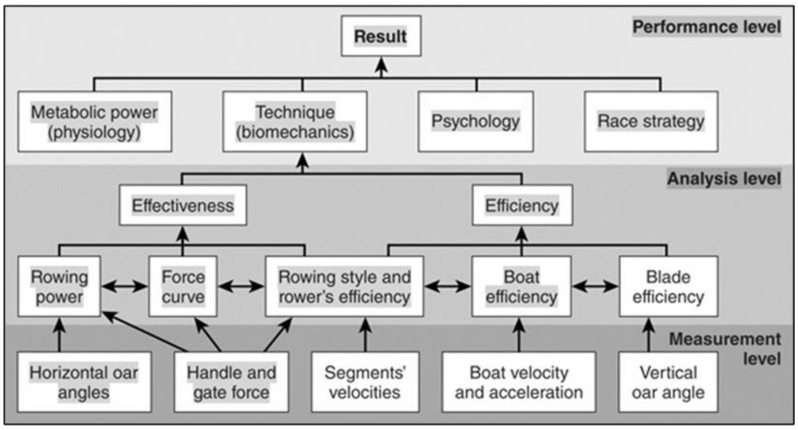

Figure 1. Simplified chart of rowing biomechanics relationship to performance (Kleshnev, 2011).

There are many variables affecting the rowing performance such as the speed of the water flow, the angle of the blade of the oar at the moment of entering the water, the rhythm of rowing, the length and sequence of rowing and the angles of the body (shoulder, trunk, knee) all such variables together lead to good performance.

Rowing is a periodic movement that begins with the catch, then the drive phase, the finish, the recovery phase and back to the catch. The catch involves placing the blade of the oar in the water, and readiness to build-up force (Smith & Loschner, 2002).

The rowing cycle can be divided into a stroke phase and a recovery phase. During the stroke phase, when the blades are in the water, the rower exerts a force on the oar handles and moves towards the bow. During the recovery phase, the blades are out of the water and the rower moves back towards the stern. Because the rower is about six times heavier than the boat, changes in velocity of the rower have marked effects on instantaneous boat velocity (Hofmijster et al., 2007).

The following points can clarify all the biomechanical factors that affect the level of achievement (Nolte, 2005): 1) The velocity of the boat is proportional to the forces resulting from pushing the water directly opposite the direction of the boat movement (strong push = high velocity). 2) The strength of the player is proportional to the surface area of the paddle, which is corresponding proportionally (vertical cuff in water = high tension). 3) When applying force against a resistor (water) there must be a waiver in the application of force and there should be no pause between these movements so as not to lose the value gained from the previous palladium. 4) The shape and type of the boat determine the amount of resistance, and then the force required to move it. 5) The movements carried out by the paddlers inside the boat greatly affect the forward resistance of the boat, in the sense that if the player remains relatively long at the end of the push and the beginning of the discard, this will result in increasing the forward part of the boat, then increase the surface exposed to resistance to water that fit the area of this surface because of the placement of the mass within the boat and the redistribution of forces. 6) Fast forward seat movement leads to the presence of reverse reaction forces in the direction of the boat movement, which negatively affects its speed. The slow motion of the sliding seat reduces the reverse reaction to speed, i.e., meaning that the lower the forces resulting from the different movements of the players, the more speed the boat gains.

The main goal of the player is to achieve the speed of the boat during the duration of the race, and this goal is simple yet difficult to achieve, as the rowing is a complex process that involves interaction (athletes, boat, paddles and water) and work around the factors that affect the speed of the boa, also this depended on race strategy, thus, information deriving from the analysis of race strategies during high-level competitions likely provides coaches and athletes more previous experience to better understand the race strategy and to regulate efforts in future competitions (Erasola et al., 2018), more other factors that are important for achieving a high standard of rowing performance include competitive rowing experience and coaching rank and suitable training (Barrett & Manning, 2004).

Therefore, the aim of this study is to focus on the importance of starting stage (250 m), in the relationship with the effect of some kinematical variables on the achievement in rowing 2000 m race.

The question of this research will be, is there different relationships between mechanical variables for the first 250 m and the achievement in Rowing 2000 m?

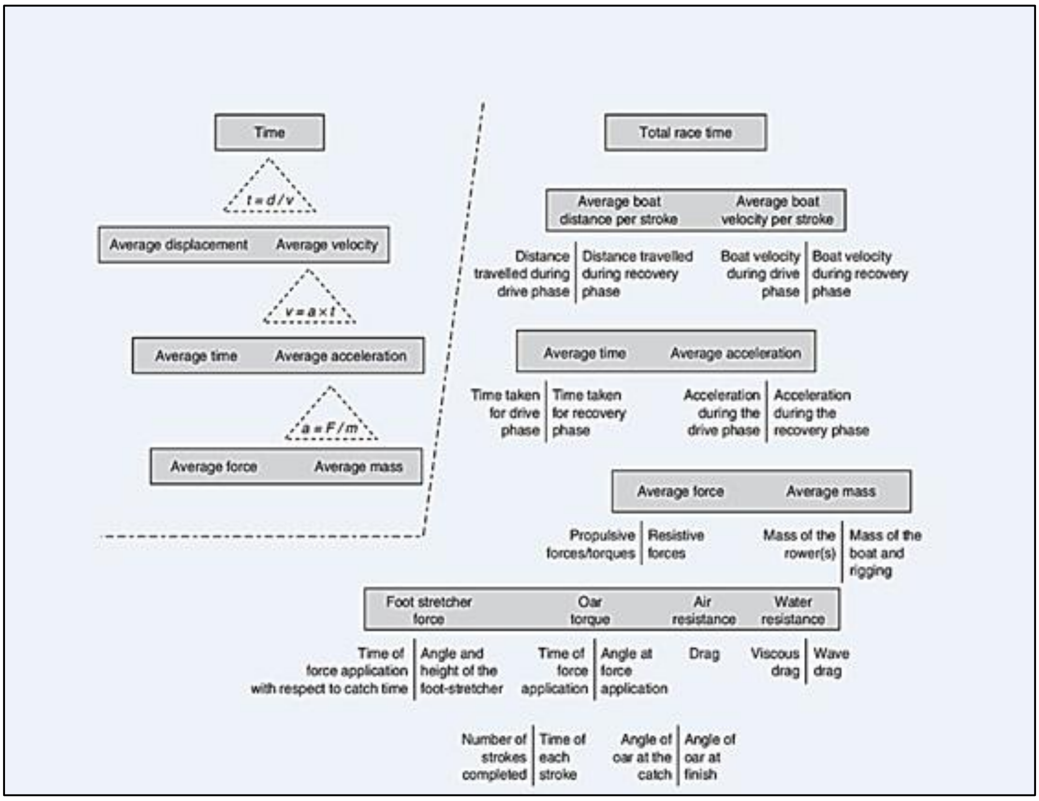

Figure 2. A deterministic model showing the basic mechanical factors of rowing that influence performance (Soper & Hume, 2004).

Methods

The study design was an analytical descriptive method linked to the relationship between variables, with the intention of selected the participants which is represented by 6 of the best achievements players from the Iraqi National Youth Team for rowing. All participants performed the test between 13:00 - 14:00 h afternoons, which is the same weekly training time for participants.

Tests used in research were: 1) The actual race time, 2) Strength test on the ergometer for three minutes with resistance to (7) on the scale of the ergometer and this degree is equivalent to water resistance (Schabort et al., 1999).

Videography was employed for the biomechanical kinematics analysis of the phase of the first (250 m), the camera that was used for this study was Sony standard camera (25f/sec) installed on a floating platform using engine moving in the same speed as the rowing boat as possible, as shown in figure 3.

The researcher analysed the phase of the first (250 m), which is a very important stage in determining the level of achievement, especially in advanced levels.

The researcher used Kinovea software for motion analysis.

Statistical Methods

Statistical Excel software is used to extract the following: The simple correlation spearman test.

Result

The mean of total achievement was (7.213 min) with (SD) of (0.092) which show there no dispersion, but in the other variables like the Intensity of the pull (watt) (SD) was (14.719) this because the different in performance and physical fitness among the players.

For the other Kinematical variables, which include the velocity and angles of the shoulder, trunk and knee joint, as well as the angle of the palm of the paddle, the number of stroke rhythm, there were no different in the participant's performance, through the results shown in the tables the value of standard deviation were low which mean the performance level of the participants were convergent, it is a guide of homogeneity of the research sample.

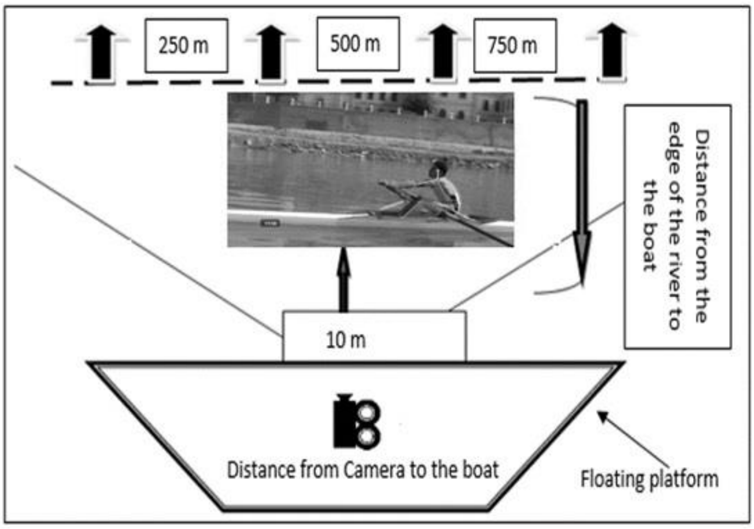

Figure 3. The way of video recording for the rowing 2000 m analyses.

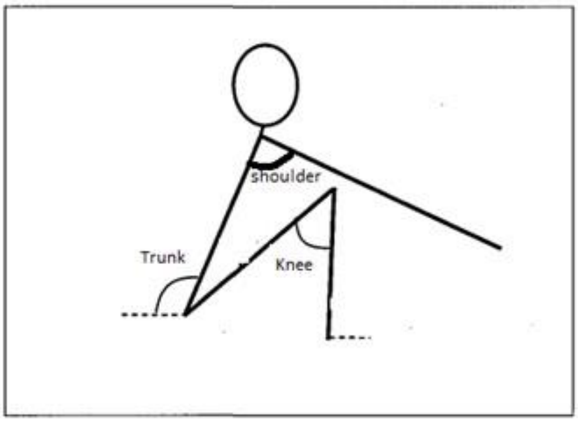

Figure 4. The measure of angles (shoulder, trunk and knee).

Table 1

The mean, standard deviations and degree of correlation of biomechanical variables with achievement in the first 250 m.

Variables	Mean	SD	Correlation with achievement
The angle of the palm of the paddle^0	21.886	0.767	0.27 +
Shoulder angle at the start of the paddle^0	91.355	0.519	0.40 +
Shoulder angle at the end of the paddle^0	28.085	1.471	0.72 +
Angle of the trunk at the start of the paddle^0	65.961	1.171	0.52 +
Angle of the trunk at the end of the paddle^0	119.797	1.770	0.27 +
Knee angle at the start of thepaddle^0	66.507	1.382	0.11 +
Number of strokes rhythm of the paddle	32.333	1.032	0.70 +
Average of the velocity m/sec	3.144	0.346	0.14 +
Angular velocity of the trunk m/sec	47.506	0.855	0.70 +
Total time of the one paddle stroke (min)	2.198	0.207	0.70 +
Average length of the one paddle stroke (m)	7.236	0.485	0.45 +
Intensity of the pull (watt)	851.666	14.719	0.74 +
Total achievement Time (min)	7.213	0.092	1

Discussion

The aim of this study was to focus on the importance of starting stage (250 m), in the relationship with the effect of some kinematical variables on the achievement of rowing (2000 m) race the level of the relationship between the biomechanical variables and the achievement was uneven in terms of the strength and weakness of the relationship.

The researcher found that relationship between the angle of the shoulder and achievement was quite strong, this indicates the importance of this variable if all the muscles of the arms and the shoulders are used much more than in rowing with the sequence being of: legs - back - shoulder - arms, as opposed to legs - back - arms.

This difference needs to be brought out in coaching, especially with athletes who have learned to row before they scull This difference needs to be brought out in coaching, especially with athletes who have learned to row before they scull which mean the rowers how start rowing in the early age (Styles, 1976).

This is very important for the prepare phase of the second stroke.

About the time of rowing stroke, the relationship was 0.70, which means a strong relationship with the total time of achievement. The stroke length also affects this in the same way, and by the time the oar is in the water and being used to propel the boat forward, , is finite, the number of rhythm of the paddle were (32.333) this match up with other studies, crews performed an incremental test consisting of four to eight efforts over 250–500m at a pace of 16–46 strokes/min(Kleshnev, 2010), the stroke rate is likely to affect the mechanical power flow in rowing.

Stroke rate is an important aspect of rowing technique and is not constant during a 2000-m race. Stroke rate is typically highest during the first and last 250 m (Hofmijster et al., 2007).

When the blade is in the water at its full extension. It ends when the work is done. Keeping it begins when the blade is in the water at its full extension, keeping the blade in the water longer and moving the hands past the body only slow forward progression. Problems occur if "the arms or the body break too soon (Ed Moran, 2009).

The angle of the trunk showed a high relation at the end of an oar stroke in comparison with the relation at the start of the stroke because of the end part of the first stroke would prepare to start the second stroke of the oar.

Despite the differences that occurred in the arm motion at the beginning and end of the drive phase, most of the kinematic variables were similar throughout the drive phase, particularly for the legs and trunk (Lamb, 1989), The lengths and inertia characteristics of the model's segments coincide with the respective parameters of parts of the human body: the arm/hand, forearm, and upper arm; the leg/foot, calf, and thigh; the head and the trunk (Zatsiorsky & Yakunin, 1991).

The Intensity of the pull very importantly in coordination with kinematic variables to improve high achievement in rowing.

Our results show that the variables differ in their relationship with the time of the first 250 m and the whole effect on the total achievement time of the race.

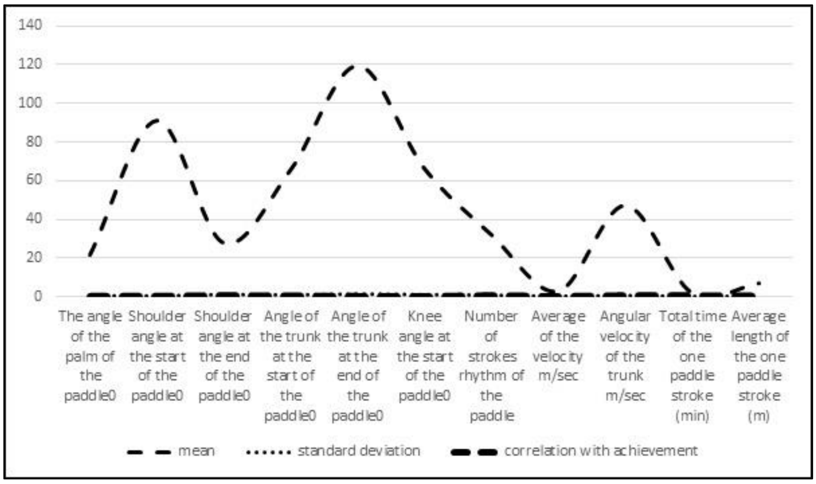

Figure 5. The results of all variables in the research.

Implication

In order to the findings of this research which clarify the different relationship of the kinematic variables with the time of the first stage of the race (250m), this implies that the coaches should focus on these variables and the how the player performs the skills.

The high performance in rowing depends on the biomechanical factors in the relationship between with power and fitness of the player, the angles Joints as well as the paddles angles during performance effect the achievement, this related to the technique of the player.

The high relationship were with shoulder angle at the end of the paddle, the number of the rhythm of the paddles and the intensity of the oars pull during the race.

One of the factors affect joints angles during the performance is the anthropometric factor, where anthropometric characteristics of the athlete and boat set-up can also affect the kinematics and kinetics of rowing (Soper & Hume, 2004), this can be a conducted study for the future in rowing.

Conclusion

Through analysed the results the researcher came out with the following conclusion:

- The first stage of the 250 m race is of great importance in determining the level of achievement.
- The level of relationship with the shoulder angle at the end of the oar stroke, the angular velocity of the trunk, the total time of the oar stroke (min), the number of strokes, the intensity of the pull was high, all these variables shown a high relationship with the achievement in rowing 2000 m.
- The level of the relationship was weak for other variables such as the rate of velocity, and the angle of the knee at the end of the oar stroke.

Recommendations

- It very important to conduct a comparative study with a universal model in rowing for identifying points of strength and weakness.
- It is also important to carry out a research for the other phases of the (2000m) race in comparison with the results of the present study.
- The results of the present research can be used as a guide for the training rowing.
- It very important to focus on the training of special endurance because of it an important factor in this types of racing which require the rower to stay in the same velocity to the end of the race, this can be as a proposed study.

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