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KINEMATICS OF SCISSORS LEG STROKE VS BREAST STROKE KICKS OF POOLS' LIFEGUARDS DURING VICTIM TUG

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ABSTRACT

This study aimed to identify the performance of lifeguards during victim tug phase through selected kinematical variables as well as to compare scissors kicks (SK) with breast stroke kicks (BK) kinematic ally. The sample of the study were 23 lifeguards who successfully passed the lifeguarding tests. A 15m maximum performance using side stroke with either SK or breast stork kicks BK ad libitum, with one hand above the water. Performance was videotaped, and data extracted from the videos were total time (TT), stroke count (SC), velocity (V), stroke length (SL), and stroke efficiency (Si). Results reveled that BS users were faster, have longer SL, less SC, and more efficient (Si). Nevertheless, the fastest lifeguard among the sample used SK, while the best average was for the BK users. However, we would recommend future implications considering larger sample, applying the study on professional swimmers, and using 3D analysis that would optimize performance of the 2 techniques.

Introduction

Aquatic activities have been considered to be one of the most appreciated and engaging activities by a wide sector of people around the world, with a big variety of ages, ranging from children to elders, and including both sexes. Aquatic activities can be easily included in both recreation and fitness routines. Furthermore, interest in aquatic activities is still exploding more and more along the past 35 years, and taking place in more countries around the world (YMCA, 2001).

Despite the fun and physical fitness advantages of aquatic activities (Aljawarneh & Atan, 2018)., unawareness of aquatic environment hazards can be as dangerous as it is fun. According to the World Health Organization (WHO), an estimated of 320.000 people died in 2016 as a result of drowning around the world (World Health Organization, 2020).

The Hashemite Kingdom of Jordan - with its relatively small population reaching around 10 million, and its geographic status that ranks it as one of the most water-scarce countries in the world (FAO, 2020) - had recorded 221 drowning cases resulting death during 2016-2019 (Jordan Civil Defense, 2020).

In addition to death as a result of drowning, a numerous number of survivals form drowning are treated and admitted to hospitals (Aljawarneh et al., 2020). A lot of those survivals still suffering from post-drowning injuries, like disability or high cost health care (World Health Organization, 2020).

Furthermore, in the United Stated, Drowning Prevention Foundation reported that 19% of drowning deaths including children occurred in public pools under the availability of lifeguards with valid lifeguard certificates. (DPF, 2010)

Reviewing scientific literature concerning lifesaving techniques, there are minimal studies dealing with this topic. The World Aquatic Health Conference, (2007) supports this view as they stated that "*many lifeguarding techniques, skills and protocols are historically based and lacks of scientific bases and standards*". This view is also supported by the United States Lifeguard Standards Coalition, (2011).

Despite the importance of all skills and techniques applied by lifeguards, the ability to reach a drowning person and move him to the side of the pool (victim-tug) is very crucial in the process of saving drowning people, especially when lifesaving equipment are not available (Alsafadi et al., 2020). Tugging victims normally done by holding the victim from the back and using the breast stroke kicks or scissors kicks. (American Red Cross, 2012; YMCA, 2001). While breast stroke kicks (BK) are well documented in the scientific literature, scissors kick (SK) is rarely sited. According to the Dictionary of sports and Games Terminology, (2010) the definition of scissors kick is "*a kick used in the side-stroke in which the legs are parted slowly then brought suddenly together*".

Due to the minimal research concerning this field (Al-Omari et al., 2020)., this study aims to identify the performance of lifeguards during victim tug phase through selected kinematical variables. As well as to compare scissors kicks with breast stroke kicks kinematically.

<u>Methods</u>

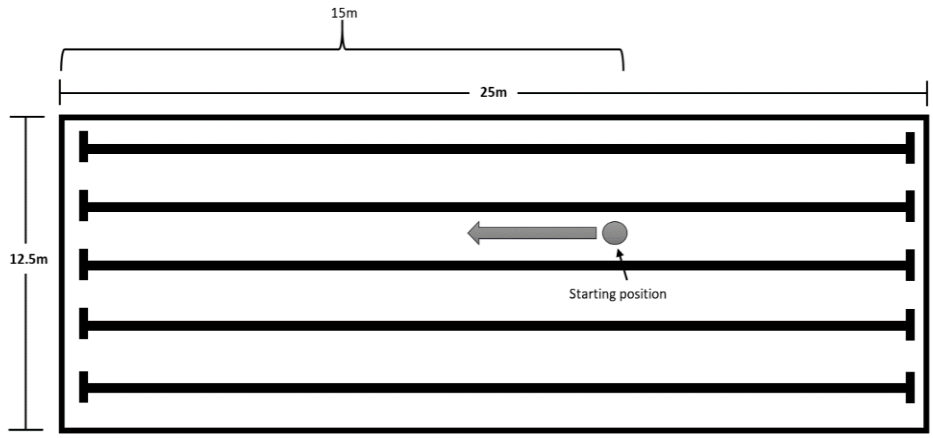
Participants

Thirty-two male participants applied for the lifeguard license in the Hashemite kingdom of Jordan (Nov, 2019), 24 of them passed the tests and 8 were disqualified. Only data of qualified lifeguards were used.

Test procedures

The study test took place in Yarmouk University's indoor swimming pool (half Olympic 25x12.5m). Starting from inside the swimming pool (without warming up) being away from the pool deck 15m to the front where the lifeguard is going to finish (figure 1), a maximum speed of side stroke using scissors kicks (SK) or breast stroke kicks (BK) with one hand above the water was videotaped for a distance of 15m. It was the lifeguards' personal choice to use SK or BK.

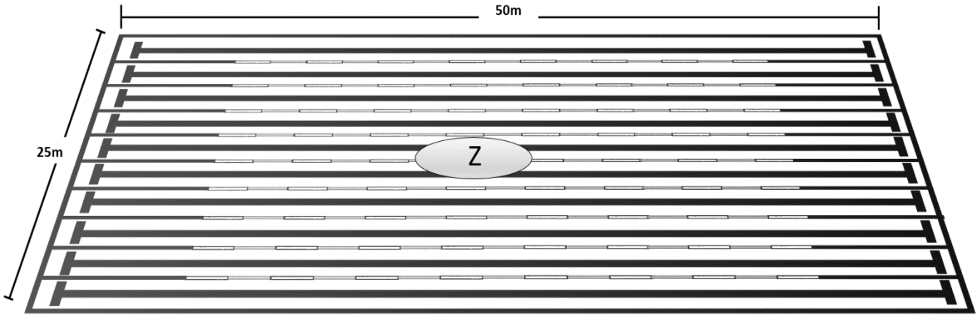
Figure (1): swimming pool diameter where the test took place, including starting position of the test.



The test distance imitates a lifeguard approaching a drowning victim for the maximum theoretical distance a lifeguard might swim in standard Olympic swimming pool (50x25m). Figure (2) depicts the longest distance a lifeguard might be obliged to tug the victim along.

Figure 2

In an Olympic swimming pool, the (z) area is where the lifeguard might swim more than 12.5m to tug the drowning victim. A miss-calculation could drive the lifeguard to swim for 15m.



Data collection

Lifeguards were recorded by a Canon D5500 camera mounted on a tripod. The position of the camera was placed at the midline of the swimming pool, at the swimming pools' balcony. The camera was roughly 4m above the floor level of the swimming pool. After the tests are done, a played back of the videos on the computer was used to the data.

Data processing

Kinematical variables used in this study are part of race analysis components of the swimming competitions used by many studies like (Ariano, 2001; Maglischo, 2003; Sanders, 2001; Smith et al, 2002)

After extracting legs kick type (BK or SK), total time (TT), and legs stroke counts (SC), and other parameters were calculated as the following:

- Average velocity (V), which is the average velocity of swimming the tests' distance. It was calculated by dividing 15m by swimming total time.

$$average\ velocity = \frac{15m}{swimming\ time}$$

- stroke length (SL), The average displacement of swimmers body made by one full leg stroke and one hand pull (. It was calculated by dividing the distance of the test (15m) by the number of the full strokes.

$$SL = \frac{15m}{strokenumber}$$

- Stroke index (Si), the product of swimming velocity and stroke length. Interpretation of this factor is the higher the stroke index number, the more efficient is the swimming technique.

$$Si = V \times SL$$

In conclusion, the variables of this study are:

total time (TT), stroke count (SC), stroke length (SL), average velocity (V), stroke index (Si).

Statistical analysis

Mean, standard deviation, minimum &maximum values, and independent t-test were used to analyze data.

<u>Results</u>

Kinematical variables for the whole sample (Mean, SD, mini, max) is shown in table (1), while descriptive data for sub-group (scissors kick and breaststroke kicks) are shown in table (2). Comparing lifeguards' performance between SK or BK, independent t-test results are shown in table (3).

Table (1): Mean, standard deviation, minimum, and maximum values for the whole sample

n = 23	Mean	Std. Deviation	Minimum	Maximum
TT	21.38	3.82	14.1	28.5
V	0.72	0.13	0.53	1.06
SC	20.76	5.27	13	34
SL	0.76	0.18	0.44	1.15
Si	0.57	0.23	0.24	1.14

Table (2): Mean, standard deviation, minimum, and maximum values for sub-groups.

	Strokes count		Time (sec)		V (m/s)		SL (m)		Si	
	BK	SK	BK	SK	BK	SK	BK	SK	BK	SK
Mean	18.43	21.79	18.53	22.62	0.82	0.68	0.86	0.72	0.73	0.50
Std. Deviation	5.56	5.15	2.70	3.61	0.11	0.12	0.212	0.16	0.26	0.19
Minimum	13	15	15.2	14.1	0.67	0.53	0.52	0.44	0.35	0.24
Maximum	29	34	22.4	28.5	0.99	1.06	1.15	1.00	1.14	1.06

BK: breaststroke Kicks; SK: Scissors Kicks, BK n = 7, SK n = 16

Table (3): Independent t-test results for the sub-groups

	Levene's Test for Equality of Variances.		T	df	Sig. (2-tailed)
	F	Sig			
time	0.291	0.595	-2.671	21	0.014*
V	0.025	0.877	2.529	21	0.020*
SL	0.304	0.587	1.772	21	0.091
Si	0.807	0.379	2.393	21	0.026*

* Significant at $p<0.05$

Discussion

This study aimed to identify the behavior of lifeguards during victim tug phase, as well as to compare scissors kicks (SK) with breast stroke kicks (BK) using selected kinematical variables.

As shown in table (1), the sample of the study performed the 15m victim-tug protocol in 21.38±3.8 sec., with fastest lifeguard covering the distance in 14.1 sec, and slowest lifeguard with 28.5 sec.Average speed was 0.72±0.13m/s. with max speed of 1.06m/s and minimum speed of 0.53m/s. As for Stroke length, the average SL was 0.76±0.18m. Longest SL was 1.15m and shortest was 0.44m. When splitting lifeguards into BK and SK, another data is presented in table (2), the average time to complete 15m of victim tug protocol using BK was (17%) faster than SK users. While the fastest lifeguard used SK with (6.6%) faster than the fastest BK user. If we sort the sample of the study according to their total time (or velocity), the fastest performer was a SK user, while the next fastest 5 were BK users.

BK users used less kicks in average (18.43 kicks vs 21.79 SK). Even the fastest and slowest BK lifeguards did lower strokes than their SK counterpart. Furthermore, stroke index (Si), or the efficiency of the kicks were better for BK lifeguards than SK (1.14 to 1.06 respectively).

As for the independent sample t-test results, with the exception of SL, all variables were significantly different in favor to BK users (less number of strokes, shorter time, higher V, longer SL, and bigger number of Si)

Conclusion and Limitations

The data of this study present a decent kinematical reference of lifeguards' performance of victim-tug protocol. While the average performance of BK was significantly better, the best performance was done by SK. This suggest that a lifeguard supposed to know his timings in both BK and SK, and assign a substantial dose of training for the preferred and fast leg kicks. A more professional lifeguards testing would give deeper understanding of those kicks in comparison to each other for lifeguards. Also, breaststroke swimmers would add a value for BK usage in this protocol. A 3D analysis would optimize the technique.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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