KINEMATICS OF TACTICS IN THE MEN'S 1500 M FREESTYLE SWIMMING FINAL AT THE BEIJING 2008 OLYMPIC GAMES

Patrycja Lipinska and Włodzimierz S. Erdmann

Jedrzej Sniadecki Academy of Physical Education and Sport, Gdansk, Poland

The purpose of this study was to obtain a knowledge on tactics of long distance swimming at the highest professional level. Eight swimmers - men, finalists of 1500 m distance of freestyle of the Beijing 2008 Olympic Games were investigated. The distribution of velocity of swimming for the entire distance based on 50 m segments was analyzed. Partial, halves and tierces velocities, velocity indexes and linear regression equations were calculated. It was revealed that better swimmers (placed 1 – 4) had their distribution of swimming as ascending line and with very small difference between segmental velocities and that of the entire distance, while the rest of swimmers had descending velocity line and higher dispersion of partial values.

KEY WORDS: swimming, tactics, kinematics, men, Olympic Games, Beijing 2008.

INTRODUCTION: There are many research articles devoted to swimming. Within biomechanics there are a lot of different approaches to this sport discipline. The most often were investigated: technique of movement of free swimming, i.e. position of body parts, stroke length, rate, velocity, and indices, technique of start and turn, improving of propulsion, diminishing of resistance forces, structure of the entire distance divided into the start segment, free swimming, turn segments, the finish segment. The scientists who devoted their research work especially to biomechanics of swimming are, e.g.: Schleighauf (1979), Hollander et al. 1985, Sanders (2000). There is a lack of investigations on biomechanics of tactics of swimming especially within the last 10 years. The theory of effort says the lowest energy expenditure is obtained when the velocity of movement tends to be steady. The differences of velocity between segments of the distance and mean velocity of the entire distance should be minimized. Also the second part of the distance should be covered with higher velocity than the first one. This was already observed by scientists of the Centre of Locomotion Research in Gdańsk in such sports as: marathon running (Lipinska, 2006), swimming (Erdmann, 2008) and in other sports. The aim of this study was to obtain knowledge on tactics of long distance swimming at the highest professional (Olympic) level.

METHODS: Data Collection: Eight swimmers (men) were investigated. They participated in 1500 m of freestyle swimming final of the Beijing 2008 Olympic Games. Data on the entire time of swimming and also split times for every 50 m (30 segments) were obtained from the Official Website of the Beijing 2008 Olympic Games (results.beijing2008.cn).

Data Analysis: Data on velocities were calculated for the entire distance and for every 50 m segment. Data on velocities were calculated also for halves and tierces of the entire distance but here the first 50 m of the distance were not included since the first meters a swimmer covers in the air after release by jumping forward from the starting block and obtains much higher velocity than for the rest 50 m segments. The entire distance without the first 50 m was 1450 m and was named quasi-entire distance (QED). The difference between the entire distance (ED) and QED is just 3.3%.

In order to compare velocities of halves (H) and tierces (T) and to assess the tendency of velocity distribution through the entire distance indices were calculated. Their calculation was based on mean velocity of the QED. The quasi-half (QH) segment (the first one) had 700 m, and the half H (the second segment) had 750 m. The quasi-tierce (QT) segment (the first one) had 450 m, the rest T segments (second and third) had 500 m. Additionally linear equations of regression for each swimmer were defined.

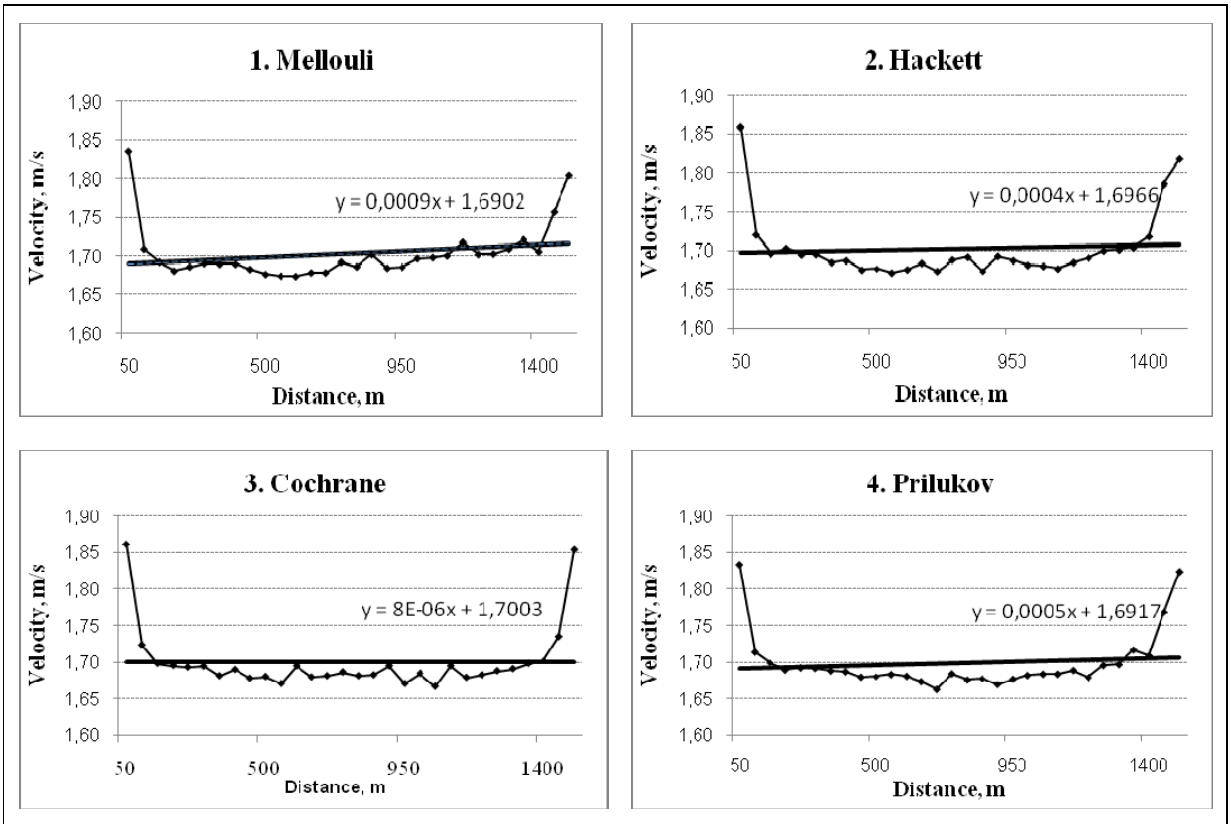
Differences were calculated between velocities of segments and QED. Then squares of differences were calculated in order to obtain only positive values. Next, sums of differences' squares were calculated. They formed velocity differences' index (VDI) for halves and tierces. The lower the VDI, the better. To compare steadiness of velocity of swimmers with different mean velocity, VDI was divided by QED. The results formed relative velocity differences' index (RVDI) for halves and tierces. To compare 50 m fragments analysis of variation was used.

RESULTS AND DISCUSSION: Looking at the velocities obtained by eight swimmers for the entire distance of 1500 m one can observe (see Figure 1) that the highest velocity was obtained for the first 50 m, then there were different tendencies of mid-distance swimming, and again higher velocity was obtained for the last 50 m segment.

Only the best four swimmers had ascending line of velocity, and the highest ascending line had the first swimmer at the finish. This is in concordance with the results obtained for the best sportspersons cited earlier. Next four swimmers had descending lines of velocity. They swam too fast at the beginning according to their possibilities. This is seen especially in a velocity line of swimmers no. 6 – 8.

Analysis of variation show substantial differences for velocities of 50 m segments, especially among one before last and last 50 m segment in comparison to the rest 50 m segments (exclusive of first 50 m).

Looking at the bars depicting mean velocities of QH and H segments (Figure 2A) one can see only the first four swimmers swam the second part of the distance faster than the first one. Looking at the bars depicting velocities of QT and T segments (Figure 2B) it is shown the winner and next three swimmers have a tendency of swimming with the middle segment the slowest but last segment is the fastest one. Again, one can see swimmers no. 6 – 8 swam the third part of the entire distance slower.



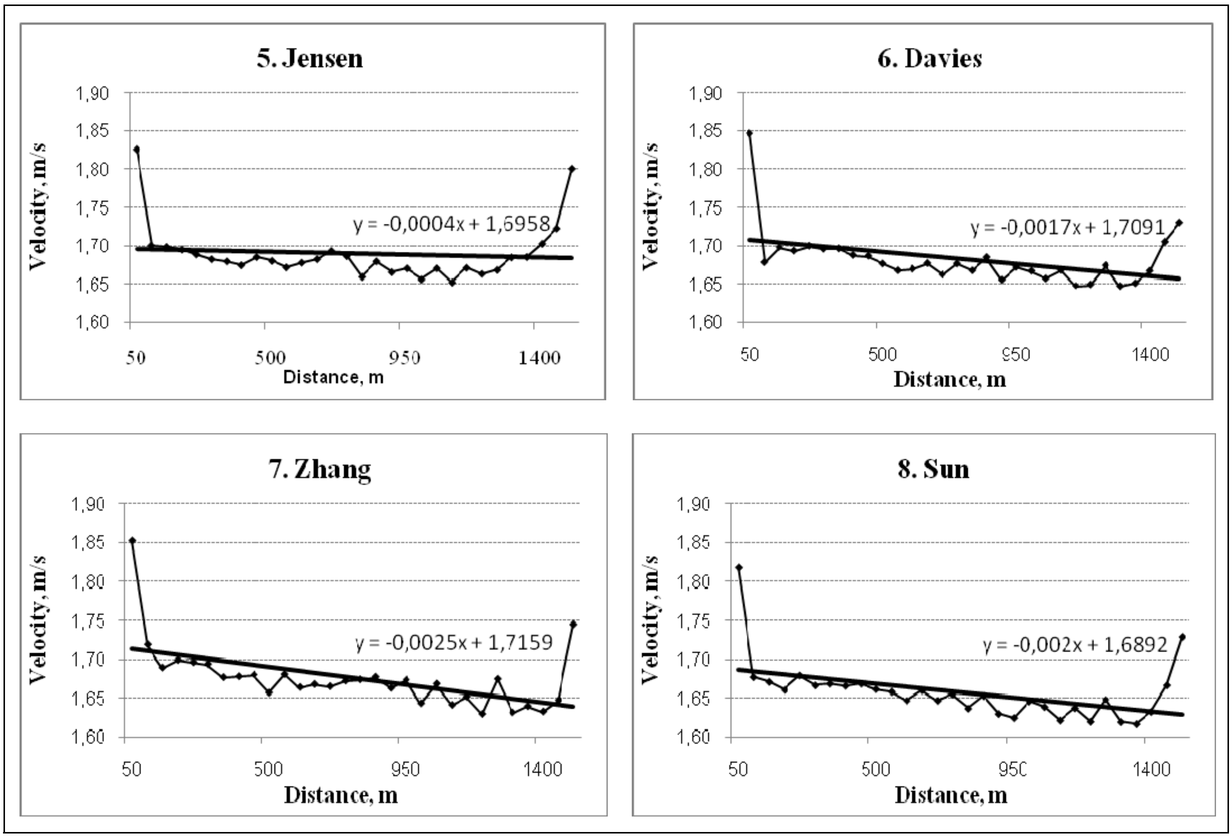


Figure 1: Mean velocities for 50 m segments of the entire distance of 1500 m. Numbers 1 – 8 are the consecutive places obtained in the competition

A B

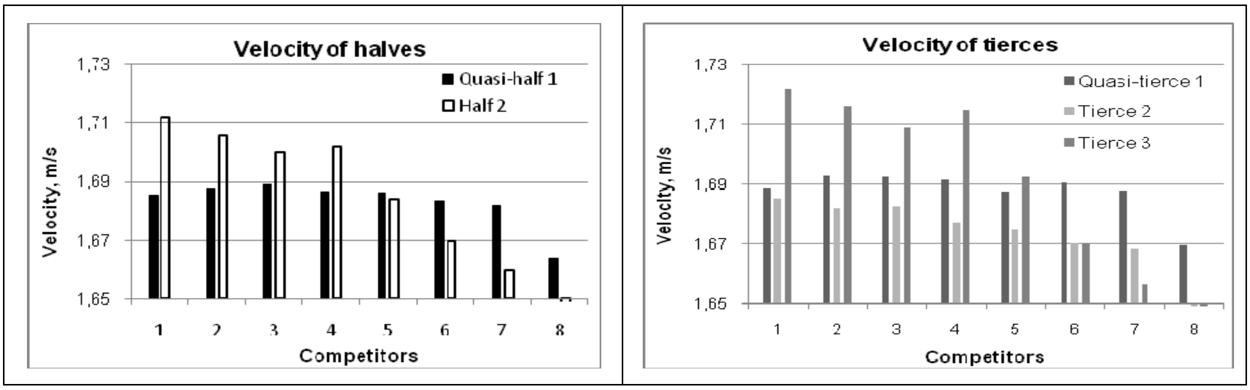


Figure 2: Mean velocities for halves (A) and tierces (B). The first half and the first tierce is without the first 50 m. Numbers 1 – 8 are consecutive places obtained in the competition

In Table 1 detailed results of mean velocities are presented. The data of indices can be assessed only with the knowledge of tendencies of velocities obtained. For example, swimmer no. 4 has indices for tierces similar to those of the winner, i. e. differences of segmental velocities according to mean velocity of the quasi-entire distance were small, and tendencies of velocity lines were similar.

Table 1 Result time (min:sec) for the entire distance and mean velocity (m/s) for the entire distance, halves and tierces and their indices: VDI - velocity differences' index; RVDI - relative velocity differences' index

No.	Name	Result time	Entire distance	Quasi-entire distance	Quasi-half 1	Half 2	Quasi-tierce 1	Tierce 2	Tierce 3
1	2	3	4	5	6	7	8	9	10
1	Mellouli Oussama	14:40.84	1.704	1.699	1.685	1.712	1.689	1.685	1.722
	VDI, RDVI				*0.351*	*0.207*	*0.829*	*0.488*	
2	Hackett Grant	14:41.53	1.703	1.697	1.688	1.706	1.693	1.682	1.716
	VDI, RDVI				*0.167*	*0.098*	*0.612*	*0.361*	
3	Cochrane Ryan	14:42.69	1.700	1.695	1.689	1.700	1.693	1.683	1.709
	VDI, RDVI				*0.064*	*0.038*	*0.357*	*0.211*	
4	Prilukov Yuriy	14:43.2	1.699	1.695	1.687	1.702	1.692	1.677	1.715
	VDI, RDVI				*0.122*	*0.072*	*0.726*	*0.428*	
5	Jensen Larsen	14:48.2	1.690	1.685	1.686	1.684	1.688	1.675	1.693
	VDI, RDVI				*0.002*	*0.001*	*0.168*	*0.100*	
6	Davies David	14:52.1	1.682	1.676	1.684	1.670	1.691	1.670	1.670
	VDI, RDVI				*0.093*	*0.056*	*0.280*	*0.167*	
7	Zhang Lin	14:55.2	1.677	1.670	1.682	1.660	1.688	1.669	1.657
	VDI, RDVI				*0.241*	*0.144*	*0.510*	*0.305*	
8	Sun Yang	15:05.1	1.658	1.653	1.664	1.642	1.670	1.646	1.643
	VDI, RDVI				*0.247*	*0.149*	*0.411*	*0.249*	

CONCLUSION: In order to approach sport performance with proper tactics sportspersons need to be taught how to achieve a good distribution of velocity of movement along the entire distance of swimming with general tendency to swim faster within the second half of distance in comparison with quasi-half 1 and swim faster in second and last tierce in comparison with quasi-tierce 1.

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