

# OXYGEN PULSE AS AN INDICATOR FOR SELECTION OF DISTANCE SPECIALIZATION AMONG SWIMMERS FROM THE SPORTS MASTERY SCHOOL IN SZCZECIN

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## Abstract

The main objective of the study was to establish the level of oxygen pulse ( $VO_2/HR$ ) within three intensity ranges in young swimmers from the Sports Mastery School in Szczecin and establishing the starting predispositions and distance specialization of the swimmers examined. The studies encompassed a group of 34 boys aged 14-17 ( $15,6 \pm 1.01$ ) who had been doing swimming for 2-10 years ( $7.34 \pm 2.12$ ). In the evaluation of the sports level of the swimmers examined there was used the "European Ranking" employing the so-called "Swimming Score Tables" of the European Swimming Federation (LEN). The oxygen performance was evaluated using the direct method by means of a progressive oxygen power test on a bicycle ergometer. The study results have been presented as split into three groups: swimmers with short distance predispositions (S), medium distance predispositions (M) and long distance predispositions (L). The long distance swimmers were characterized by the highest value of oxygen pulse. The highest increase in oxygen pulse in the course of progressive exertion was observed in the group of medium distance swimmers. The lowest oxygen pulse characterized the group of short distance swimmers. For long distance swimming there should be directed the swimmers having a very high oxygen pulse, at the 2nd level of intensity. For medium distance swimming there should be directed swimmers with the highest increase in oxygen pulse between the 2nd and 3rd level of intensity. The swimmers characterized by low oxygen pulse at all levels of intensity may achieve successes in swimming only on short distances, where what plays a bigger role than the oxygen indicators are the somatic conditions, body type and thrust.

## Introduction

Swimming is one of the most popular and attractive forms of active recreation. It is a basis for pursuing many sports domains and disciplines, and derivatives thereof, that are carried out in aquatic environment (Łubkowska and Paczyńska, 2013), which are generally available for people of various ages and having various dexterity levels (Zatoń and Kwaśna, 2011). It is promoted as a "sports discipline for everyone" that can be done at any point of life, with indication of a wide range of its positive effects for health as well as its positive corrective and therapeutic influence (Cieślicka et al., 2011; Dolata-Łubkowska and Kruk, 1996; Łubkowska et al., 2014). It is an ideal form of active rehabilitation for the disabled (Radzimińska et al., 2013), and the socially

maladjusted (Bartik, 2009). It is considered a form of activity that is characterized by a low risk of injury (Cumps et al., 2008; Nicholl et al., 1991).

It is also a sports discipline included among the fundamental Olympic disciplines. It includes a wider array of male and female competitions, starting from 50 m and ending at 1500 m, which results in division of swimming distances into short (50 and 100 m), medium (200 and 400 m) and long (800 and 1500 m). In relation to this, in swimmers who participate in different competitions we are dealing with various levels of intensity of swimmer training (Łubkowska and Troszczyński, 2013).

The selections of training loads at the stage of directed and specialist training has to take into account the individual biological development of swimmers (Łubkowska and Troszczyński, 2006). The load of a swimmer training should be properly adjusted to the swimming distance. Young swimmers often complain about the lengths of distances they have to swim during trainings. It applies particularly to short distance swimmers, for whom a large training volume is tiring and the motor preparation of these swimmers should be based mostly on strength (Kalczyński et al., 2005), speed and mastery of technical elements of the race - starting jump and turns, with simultaneous focus on appropriate psychological preparation. Morphological indicators are also going to play a large role for short distance swimmers (Kalczyński et al., 2006). Therefore it is very important to select the training loads properly, which is underlined by Łubkowska and Troszczyński (2006).

The results of studies conducted by Makar et al. (2010) prove that by controlling the swimming technique it is possible to carry out correct sports development of a swimmer without having the trainer apply stimuli consisting in excessively large training volume. A female swimmer who was studied by them during a three year training cycle carried out the average annual value of training volume at the level of only 1290 km, while the training volume recommended in the literature amounts to over 2300 km a year at that stage of training.

As Bielec (2012) remarks rightly, in sports swimming there are observed many cases of high results achieved in the category of children and youth by swimmers who, shortly afterwards, abandon any interest in training. The analysis of the course of career and results of the twenty highest ranked 11 year old girls competing in the Correspondence Championship of Poland of Children Aged 10-11 has shown that only 30% of the participants examined took part in the Polish Junior Championship for youth aged 17-18 carried out within the scope of the Polish Youth Olympics, while 40% of girls from the examined group finished their career until the age of 15 and the style and distance specialization has changed in 80% of cases (Bielec, 2012). Focusing training activities on temporary effects and early specialization often contributes to premature resignation from doing swimming by young swimmers who would have been potential candidates for future champions if their development had been stimulated properly (Sozański et al., 2008).

Swimming trainings should be therefore varied and designed according to the modern trends of sports developments fitting into the ideas of the humanistic dimensions of physical culture (Pypka et al., 2010) and Olympic humanism, so that the swimmers could eagerly participate in them. What is of fundamental importance here is the ability of correct programming of the training cycle featuring properly selected exertion loads encompassing training volume and intensity (Płatonow, 1997; Łubkowska and Troszczyński, 2006; Łubkowska and Troszczyński, 2011). In order to establish swimming distance predispositions a trainer should employ various tests (Łubkowska and Troszczyński, 2014; Napierała et al., 2010) that may be treated as an important element when it comes both to health and sports successes

(Łubkowska and Troszczyński, 2014; Żukowska and Szark, 2010). One of them is establishing the oxygen pulse at various intensity levels.

Unfortunately, among the plenty of research issues regarding swimming there are no elaborations that would present the dependencies between distance predispositions of swimmers and the physiological parameters consisting of the so-called oxygen performance indicators (Łubkowska and Troszczyński, 2011) and particularly the oxygen pulse at various intensity levels.

The objective of this study was establishing the level of oxygen pulse ( $VO_2/HR$ ) within three intensity ranger in young swimmers from the Sports Mastery School in Szczecin and then, on the basis of the  $VO_2/HR$  measurement conducted, establishing distance specialization of the swimmers examined.

## Methods

The studies encompassed a group of 34 swimmers aged 14-17 ( $15,6 \pm 1.01$ ) doing swimming in the Sports Mastery School in Szczecin. This school belongs to the best ones in the country where the selection is the most strict both with regard to number and significance of the selection criteria (Eider, 2014). From this school come, among others, the swimmers qualified to the National Swimming Team and then to the Polish Olympic team. In the group created there were included swimmers who had been training swimming for 2-10 years (the average training period of all the examined swimmers amount to  $7.34 \pm 2.12$ ). The training was compliant with the principles of the Polish Swimming Federation.

Evaluation of the morphological development of the swimmers examined was carried out on the basis of body mass and height measurements. The oxygen performance was evaluated using the direct method by means of a progressive oxygen power test, consisting in making physical effort with increasing load until refusal to continue. The test was carried out on a ER900 bicycle ergometer of the Jaeger company, using the methodology proposed by Wasserman et al. (1987), Bentley (2007) and Bishop and Edge (2005). The test applied enabled establishing the oxygen pulse level –  $VO_2/HR$  [ml/contraction] within three intensity ranges.

In the evaluation of the sports level of the swimmers examined there was used the “European Ranking” employing the so-called “Swimming Score Tables” of the European Swimming Federation (LEN 2014). From among all the sports results in the career of each swimmer examined there was underlined his best result (the best time achieved) obtained during competitions, in reference to the primary distance and style in which a given swimmer competes. If the results at the highest sports level were obtained on distances of 50 and 100 m, the swimmer was assigned to the group specializing in short distances (S). If the best results were obtained on distances of 200 and 400 m, the swimmer was assigned to the group specializing in medium distances (M). And finally, if the best results were obtained on distances of 800 and 1500 m, the swimmer was assigned to the group specializing in long distances (L). In this way the swimmers have been divided into three groups: S – short distance specialization, M – medium distance specialization and L – long distance specialization (Table 1). The criterion for assignment to a given group was the distance specialization of a given swimmer.

The data obtained during measurements was subject to statistical calculations.

**Table 1.** Criteria for division of swimmers into distance specializations: short distance (S), medium distance (M) and long distance (L)

Distance - based specialization	Group	
50, 100 m	Specialization in short distances	S
200, 400 m	Specialization in medium distances	M
800, 1500 m	Specialization in long distances	L

## Results

All the study results have been presented as split into three groups: swimmers with short distance predispositions (S), medium distance predispositions (M) and long distance predispositions (L).

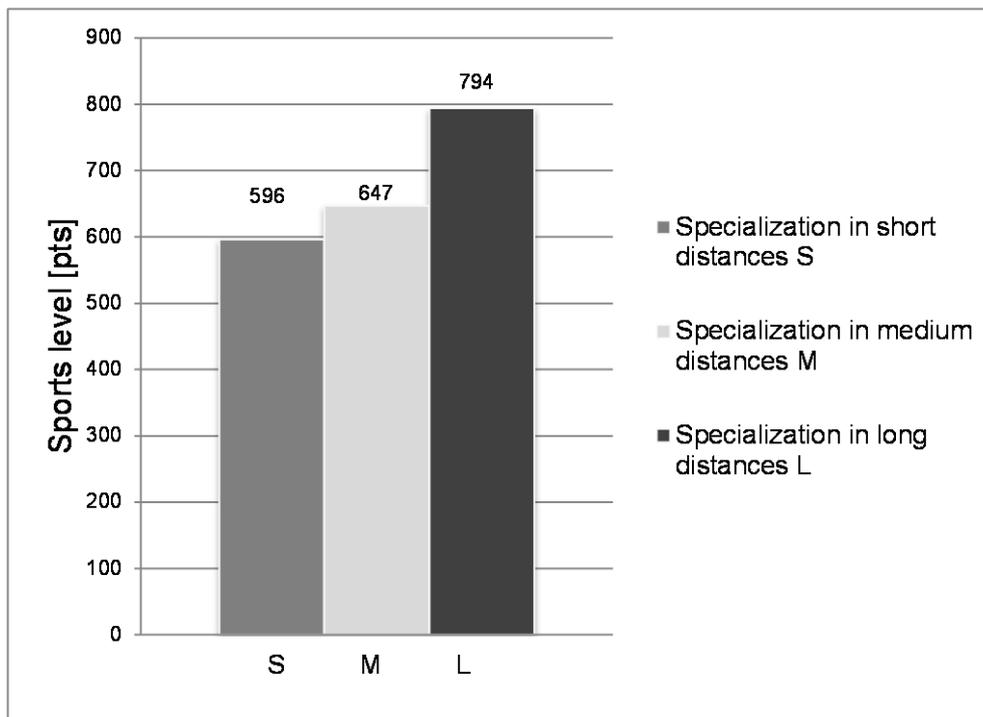
In table 2 there have been provided the numerical characteristics of morphological development of the swimmers examined with taking into account their distance specialization. When it comes to height parameters the largest mean body height characterized the boys from the short distance specialization group (S) - it amounted to 188.9 cm, followed by the boys from the long distance group (L) - 185 cm. In the medium distance specialization group (M) of the examined swimmers the mean body height was the smallest and amounted to 184.8 cm. These differences are not statistically significant.

When it comes to weight parameters all the swimmer groups (S, M and L) had a similar body weight: 69.4 kg – group S, 71.9 kg – group M and 68.90 – group L. This parameter, similarly to the body height, also does not differentiate the groups examined.

**Table 2.** Numerical characteristics of morphological development of the swimmers examined with taking into account their distance specialization (M±SD)

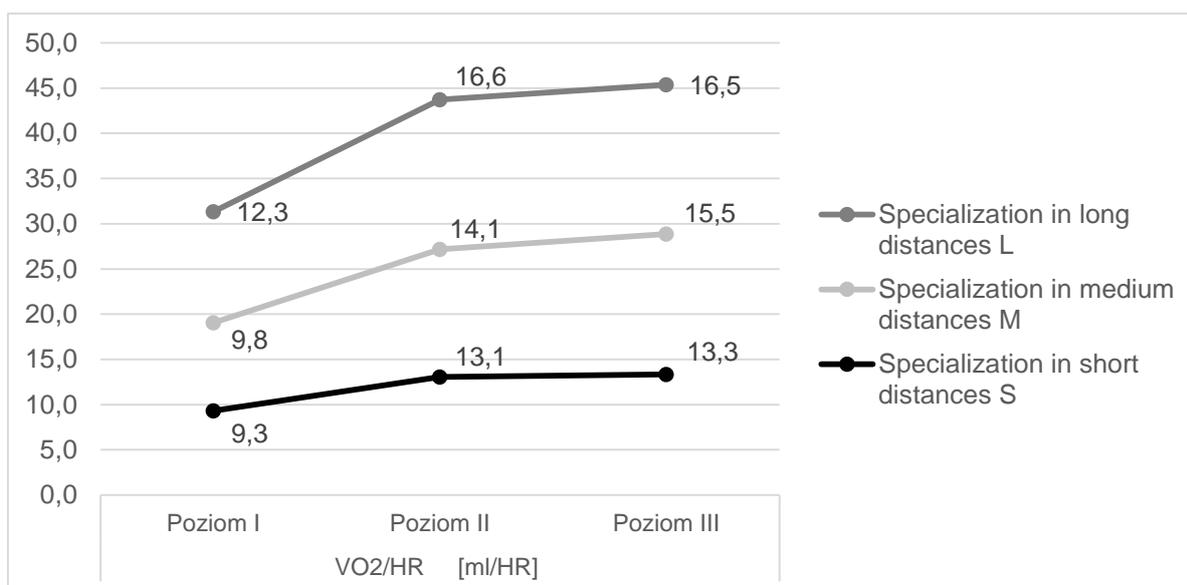
Group (Distance-based specialization)	n	Age [years]	Height of the body [cm]	Mass of the body [kg]
S	15	15,2±0,6	188,9±3,7	69,4±10,1
M	11	15,7±1,1	184,8±3,7	71,9±7,6
L	8	15,9±1,0	185,0±4,2	68,9±9,6

The results of tests diagnosing the sports level of the swimmers examined, divided (according to table 1) into: sprinters (S), medium distance swimmers (M) and long distance swimmers (L), have been presented on figure 1 by means of points [pts]. The highest sports level characterized the swimmers belonging to the long distance predisposition group (L) - 794 [pts]. Next was the medium distance predisposition group (M) with 647 [pts] and the short distance predisposition group (S) with 596 [pts].



**Figure1.** Sports level indicators of the swimmers examined [pts] according to LENA score tables, divided into: sprinters (S), medium distance swimmers (M) and long distance swimmers (L)

On the figure 2 there have been presented the results of physiological parameter measurements, showing the body's potential for physical effort and circulatory-respiratory effort within the scope of maximum values, including the oxygen pulse  $VO_2/HR$  [ml/contraction] on three levels.



**Figure 2.** Oxygen pulse indicators -  $VO_2/HR$  [ml/contraction] of young swimmers, divided into three intensity ranges - level I, II and III

When analyzing the graph presented (Fig. 2), by comparing the groups of short distance swimmers and medium distance swimmers it can be stated that at the 1st level of oxygen pulse the difference to the benefit of the medium distance swimmers rises together with the increase in intensity and it amounts to 0.5 [ml/contraction]. At the 2nd level of oxygen pulse we can observe that the difference continues to rise to the benefit of the medium distance swimmers and amounts to 1 [ml/contraction]. At the 3rd level of oxygen pulse the difference still continues to increase to the benefit of medium distance swimmers, amounting to 2.2 [ml/contraction].

When comparing the group of medium distance swimmers and long distance swimmers (Fig. 2) it can be said that with the increase in intensity the difference to the benefit of the long distance swimmers also rises and amounts to: 2.5 [ml/contraction] at the 1st level of oxygen pulse, 2.5 [ml/contraction] at the 2nd level of oxygen pulse and 1 [ml/contraction] at the 3rd level of oxygen pulse.

If we compare the short distance group to the long distance group (Fig. 2) it can be stated that the difference at the 1st level of oxygen pulse increases together with the rise in intensity to the benefit of the long distance swimmers and amounts to 3 [ml/contraction]. At the 2nd level of oxygen pulse this difference grows larger and amount respectively to 3.5 [ml/contraction], while at the 3rd level of oxygen pulse it lowers slightly down to 3.2 [ml/contraction].

At the current state of training, the swimmers from the long distance group are characterized by the largest oxygen demand at the 2nd level of oxygen pulse - 16.6 [ml/contraction]. This would correspond also to the intensity of swimming long distances. In the medium distance group the highest oxygen pulse - 15.5 [ml/contraction] occurs at the 3rd level of the pulse. This group is characterized by the largest oxygen demand during the maximum and submaximum intensity of swimming, where the duration of starting effort is within 2 to 4 minutes. It is necessary to consider differently the oxygen demand in the group of short distance swimmers, since the time of starting effort, which is very short (ca. 23-55 seconds) does not allow the body to adjust to the maximum oxygen absorption. On the other hand, the oxygen debt occurring after the finished exertion is regenerated by the body (Łubkowska et al., 2014). It seems therefore that this type of examinations is not significant for short distance swimmers.

## **Conclusions**

To summarize the study results obtained the following conclusions can be made:

1. The long distance swimmers are characterized by the highest value of oxygen pulse.
2. The highest increase in oxygen pulse in the course of progressive exertion was observed in the group of medium distance swimmers.
3. The lowest oxygen pulse characterizes the group of short distance swimmers.
4. The predispositions of swimmers for short, medium and long distances can be established by analyzing all the starts of a given swimmer using the LENA tables.
5. For long distance swimming there should be directed the swimmers having a very high oxygen pulse, at the 2nd level of intensity.
6. For medium distance swimming there should be directed swimmers with the highest increase in oxygen pulse between the 2nd and 3rd level of intensity.
7. The swimmers characterized by low oxygen pulse at all levels of intensity may achieve successes in swimming only on short distances, where what plays a

bigger role than the oxygen indicators are the somatic conditions, body type and thrust.

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