

RATING TRAINING LOAD OF DISABLED SWIMMERS IN GENERAL PREPARATION SUB-PERIOD

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Abstract The aim of the work was to assess the training loads of disabled swimmers in the comprehensive preparation sub-period. The research was carried out on 12 swimmers of the WZSN "START" Wrocław swimming club section. All swimmers started in the "S" start group. The average age of swimmers was 24 years and the average training time was 8 years. The pulse rates were analyzed 6 times during the training, just before the training, in the 10th minute of the warm-up, in the 45th minute at the peak of the training, in the 80th minute, in the 90th minute immediately after the training, and in the 105th minute after the rest. A Polar 810i Sport-tester was used to evaluate the heart rate. Statistical analysis was used. For all the swimmers the average heart rate values after 15 minutes of rest did not return to resting heart rate values. In addition, the swimmer's fatigue was assessed using the Borg scale. The training load was moderate, and on the Borg scale, the swimmers assessed their fatigue as very heavy.

Key words training loads, swimming by people with disabilities, general preparation sub-period

Introduction

The level of sport swimming in people with disabilities has increased significantly in recent years. Competitors divided into groups and starter classes are achieving increasingly better sporting results in virtually all swimming competitions (Seidel, Bolach, Kachnikiewicz, Walowska, 2012; Zając, Seidel, 2007).

In the functional classification, three starter groups are distinguished: "S" – freestyle, backstroke and butterfly, "SB" – classic, and "SM" – medley (Uściniowicz, Seidel, Zastawa, Klich, 2013). In the annual training cycle, three periods are distinguished: preparatory, starting, and transitional. According to W. Seidel et al. (2012), the preparatory period is a long training cycle and is divided into three sub-periods:

- general preparation to develop strength, endurance, speed, and swimming technique,
- targeted preparation of increased effort,

- special preparation of improving swimming technique and speed endurance.

The training load consists of increasing the amount and intensity of swimming across the training sub-ranges. The easiest method of evaluating training intensity is by measuring the heart rate (HR). The training load and selection of training measures are related to many factors such as: age, gender, fitness, and the degree and type of disability. The principle of “super-individualization” is the individual adaptation of the training to these factors, as well as to the predisposition, and the distance the athlete chooses. Therefore, the training process for disabled swimmers is much more difficult than with able-bodied people, both in planning and implementation (Costill, 1998; Karpiński, Sachnowski, Oprychał, 2005; Szafranec, Seidel, Kruszyna, Żurowska, 2012; Zatoń, Jaszak, 2008; Żurowska, Seidel, 2009).

Aim of the study

The aim of the study was to assess the training loads of disabled swimmers in the general preparation period.

Material and research methods

12 swimmers from WZSN “Start” Wrocław were studied. The competitors started from four sporting and medical groups:

1. From group I – classes B2 and B3.
2. From group III – classes A2, A3, A4 and A8.
3. From the fifth class group – LA5 and LA6.
4. from the sixth class group – CP5, CP7 and CP8.

In terms of functionality, they participated in in classes “S7” to “S13” of the “S” start group. The most numerous groups were amputated and dysfunctional swimmers with lower limb dysfunctions. Six of the swimmers used orthopedic equipment for mobility. The age of the swimmers ranged from 14 to 43 years (average 24 years) and had a swimming experience from 3 to 16 years (average 8 years) (Table 1).

Table 1. Characteristics of the disabled swimmers

Age	Experience (in years)	Education	Sporting medical class	Start class	Type of dysfunction
34	11	Secondary	B2	S12	Visually impaired
21	6	Secondary	B3	S13	Visually impaired
20	13	Secondary	A2	S9	Unilateral thigh amputation
19	4	Secondary	A3	S8	Bilateral amputation of the lower leg
14	7	Basic	A4	S10	Unilateral amputation of the lower leg
16	7	Basic	A8	S9	Dysmelia – hypoplasia of the left upper limb
17	9	Basic	LA5	S10	Limiting the range of motion in the hip joint
30	3	Higher	LA5	S10	Ankle joint stiffness
29	12	Higher	LA6	S10	Total hand failure
19	5	Secondary	CP5	S7	Cerebral Palsy
27	16	Higher	CP7	S7	Cerebral Palsy
43	3	Higher	CP8	S8	Spasticism of both lower limbs following craniocerebral trauma

Research Method

The tests were performed in January 2018 during the comprehensive preparation sub-period, in the final 10-day microcycle. Heart rates (HR) were analyzed at 6 moments of the training unit: immediately before training, in the 10-minute warm-up, at the peak of the training (at 45 minutes), in the final part of training (at 80 minutes), immediately after the training (at 90 minutes) and after 15 minutes of rest. A Polar 810i chest mounted heart rate sensor was used to assess heart rate. Additional braces were also used to hold the strap around the chest at high speeds. The level of fatigue was assessed using the Borg scale (no fatigue – 1, maximum fatigue – 20).

The level of significance in the analysis was $p < 0.05$. Calculations were made using the Statistica program. The relationship between the pulse rate and the factors considered was assessed using Student's t-test in independent groups, and the Pearson linear correlation coefficient was determined (Luszniewicz, Słaby, 2001).

Results

Heart rates during the general preparation training period

A noticeable increase in pulse was seen during the first 45 minutes, up to the training peak, after which it progressively decreased. The heart rate variation was not very high (coefficient of variation did not exceed 10% at each of the tested training moments). After the 15-minute rest, the heart rate gradually slowed toward the initial value, but did not reach it (Table 2).

Table 2. Average heart rates (HR) during the general preparation training units

Pulse	\bar{X}	SD	Minimum	Maximum
Resting	77.0	3.9	72	84
At 10 min.	142.3	6.8	131	153
At 45 min.	200.0	10.4	182	216
At 80 min.	160.3	6.4	147	171
At 90 min.	114.8	6.5	104	126
After 15 min. rest	84.6	5.4	75	91

The fastest changes in average heart rate were found in the first and last 10 minutes of training. The rate of increase between 10 and 45 minutes was faster than the decreases between 45 and 80 minutes (Figure 1).

In the first 10 minutes of warmup exercises, the average heart rate rose by 6.5 ($142.3 - 77 = 65.3$) beats per minute (bpm). A similar result could be seen in the last 10 minutes, where the value was 4.5 bpm. It should be noted that the rate of decline in average heart rate after 15 minutes of training was slower than during 10 minutes of dissolution (Figures 2 and 3).

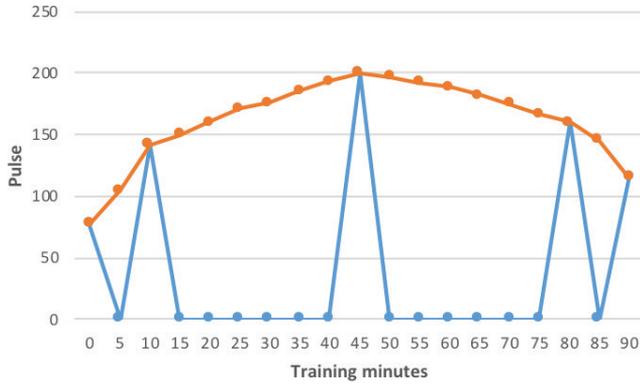


Figure 1. Average heart rates during the general preparation training

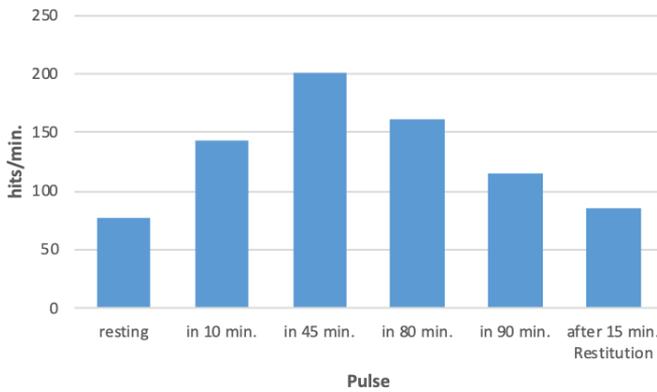


Figure 2. Average heart rates at selected moments of the general preparation training

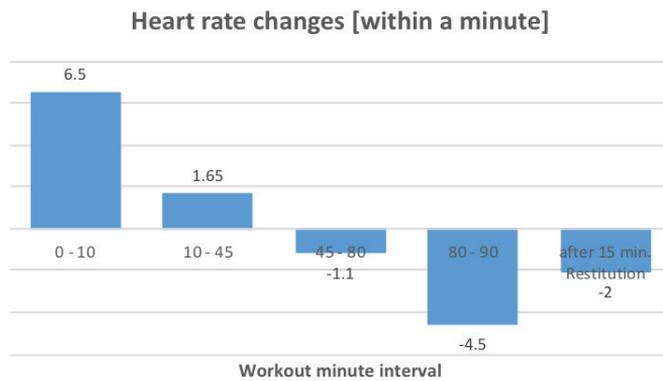


Figure 3. Average rate of pulse change [HR] at selected times of the training units in the tested microcycle (a negative value means a decreasing heart rate)

After 15 minutes of rest, the average HR value was higher than the average resting heart rate. These differences ranged from 2 to 16 bpm. The difference between these measurements was statistically significant (Table 3).

Table 3. Comparison of average resting heart rate (HR) and after 15 minutes rest

Pulse	\bar{X}	SD \pm	Average difference	Student Test	
				t	p
Resting [T0]	77.0	3.9			
After 15 min. rest	84.6	5.4	+7.6	5.71	0.0001

Changes in heart rate after a 15-minute rest were correlated with mean resting heart rate values ($r = -0.5$). The negative sign of the correlation coefficient was surprising, which means that the swimmers who had a higher peak heart rate after 15 minutes of rest had a similar heart rate value to the resting value than people who had a lower peak heart rate (Table 4).

Table 4. Average peak heart rate values depending on the difference between resting heart rate and after a 15-minute restitution

Difference between resting heart rate and pulse after rest [T0 – Test]	Peak heart rate (bpm/bpm)		Student Test	
	\bar{X}	std. dev.	t	p
<5	205.3	8.8	1.96	0.108
>10	190.7	11.0		

The rate of change in average heart rate in the first and second half of training had a correlation to the difference between the resting heart rate and the rate after 15 minutes of rest. Both correlations were negative, which shows that the faster the average heart rate increased in each part of the training, the closer the pulse rate after 15 minutes of rest was to the resting pulse rate. The most significant difference was the change in average heart rate from the peak to the final. This correlation was stronger and statistically significant (Table 5).

Table 5. Correlation of average heart rate changes between resting heart rate and after 15 min rest

Changes in heart rate	Correlation with ($T_0 - T_{rest}$)	
	r	p
$T_{max} - T_0$	-0.43	0.165
$T_{max} - T_{90}$	-0.65	0.023

Average changes in heart rate and fatigue according to Borg scale

Disabled swimmers described their fatigue after training as severe, with most of them as very severe (Table 6).

The examined swimmers rated their level of fatigue within 15–19 points of the Borg scale ranking, with an average of 17.25 points and a standard deviation of 1.22 points. The fatigue felt by the swimmers was slightly related

to the peak pulse value. The Pearson linear correlation coefficient $r = 0.13$ and was not statistically significant. However, it was found that clearer correlations of the subjective feeling of fatigue were associated with the pace of changes in the second half of the training, and the difference between the average resting heart rate and after the rest. Correlations had opposite signs, which meant that a greater decrease in heart rate between 45 and 90 minutes of exercise were related to higher fatigue after training (Table 7).

Table 6. Subjective assessment of fatigue of disabled swimmers according to the Borg scale

Evaluated effort	Borg score	Indications	
		n	%
Hard	15–16	3	25
Very hard	17–18	7	58
Maximum	19–20	2	17

Table 7. Correlations of average heart rate changes with subjectively felt fatigue according to the Borg scale

Changes in heart rate	Correlations with fatigue on the Borg scale	
	r	p
$T_{\max} - T_0$	0.19	0.553
$T_{\max} - T_{90}$	0.31	0.328
$T_0 - T_{\text{rest}}$	-0.30	0.338

Summary

Training loads depend on many factors, such as the style in which a sportsperson specializes (Jeffrey, Bauerle, 2004; Karpiński et al., 2005; Morouco et al., 2011; Neiva, Fernandes, Vilas-Boas, 2011; Ogonowska, Hubner-Woźniak, Kosmol, Gromisz, 2009; Skórka, Ogiermann, Wilk, 2011). In styles where the lower limbs do more work, more energy is derived from anaerobic sources. Over long distances, energy sources derive from oxygen sources. In training at an intensity of approximately 80% $VO_{2\max}$, the heart rate should be between 120 and 150 bpm (Kosmol, Hugner-Woźniak, Staniszewski, Stomiński, 2000; Morouco et al., 2011; Neiva et al., 2011; Skórka et al., 2011; Szafraniec et al., 2012). Similar values were obtained for the tested disabled swimmers from “Start” Wrocław in the initial and final phases of effort. However, with an increase of training load to 90% $VO_{2\max}$, the heart rate rose to 170 bpm. In this case, one could speak of shaping aerobic fitness. The swimmers obtained similar pulse rates at 30 and 70 minutes of training. In contrast, heart rate values at the peak of the training unit indicated a training load of up to 95% $VO_{2\max}$, which meant that the load is anaerobic lactic acid.

K. Zatoń and M. Jaszczak (2008) examined a group of 9 athletes from the Polish Olympic swimming team and found that the intensity of effort of the competitors was within the scope of aerobic training. Anaerobic and mixed effort was much less frequent. According to D.L. Costill (1998), training should oscillate more within the range 120–150 bpm, i.e. medium oxygen intensity training. However, at the time of the main training task, anaerobic loads should prevail. This training pattern is designed to increase the strength of players.

In conclusion, it should be noted that the load during training is significant, as indicated by the fatigue values given by the competitors on the Borg scale and peak heart rate values, as high as 185 bpm. This is also confirmed by the fact that none of the competitors had a pulse rate return to the resting heart rate after the 15-minute rest. Aerobic effort prevailed in the training unit, while at the time of the main task this effort was mixed, and even anaerobic.

Conclusions

1. The pulse value of any of the swimmers after 15 minutes of rest did not return to the resting value.
2. Disabled swimmers experienced significant training loads in the studied microcycles of the general preparation sub-period.
3. On the Borg scale swimmers rated their fatigue as very severe.

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