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Effects of Interval Sprint Trainings on Heart Rate and 50 m Swimming Performances of Young Male Swimmers

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Abstract

Achieving superior performance in swimming, as in other sports, depends on the customization of training for young athletes. The aim of this study was to investigate the effects of sprint interval trainings on heart rate and 50 m swimming performances of young male swimmers. 24 young male swimmers joined to the study by having their parents confirm the "Parental Permission Form". Swimmers randomly divided into two groups as normal training group and interval sprint training group. As normal training group continued the routine swimming training, interval sprint trainings (8 x 50 interval repeats in crawl and backstroke styles) were applied to the other group additionally for 8 weeks, 3 days a week, at least 30 min a day. Rested-maximum heart rate, 50 m sprint swimming test in crawl and backstroke styles were applied to the swimmers in 1st and 8th weeks of the period. The analysis of data was made in the statistical package program by using "Descriptive statistics", "Paired t Test" and "Independent t Test" for comparison. Results of pre- and post-test comparison of each group, significant differences were found in resting heart rate values of normal training group and all values of interval sprint training group ($p < .05$). Results of comparison between groups, differences found statistically significant in 8th week maximum heart rate, crawl and backstroke performances ($p < .05$). To conclude, we could say that the reason of finding significant differences in rested and maximum heart rate is the positive effects of physical activity on the cardio-vascular system (adaptation). And, the reason for the positive effects on sprint interval performance is depended on sprint interval swimming was acute origination of body's physiological reaction to rising energy need during short time and intensive physical activity even in micro plan.

Keywords: swimming, interval, sprint, performance

1. Introduction

Swimming is a sport that provides the most perfect manner of physical development in the water, allows muscles to work in harmony and in accordance with each other, since gravity drops down to almost zero in water. Swimming also increases the resistance of body without showing any corrosive effects while it is performed against the resistance of water. In particular, the contribution of the childhood swimming, physical and psychological development of athletes has been carried out in many scientific and important studies. On the other hand, swimming is also one of the rare sports used in physical therapy which enables the symmetrical and balanced development of muscles of the body (Bozdoğan, 2006; Koca, 2003).

It is undisputed that every sports branch like swimming strengthens oxygen-consuming, expands blood vessels and the heart rate. However, the heart and circulatory system work more comfortable in swimming, because it is performed in a horizontal position. Therefore, the circulatory system of the swimmers is more harmonious than other athletes. The resting heart rate of swimmers is low. In addition, heart rate and blood pressure may increase during the activity of swimming (Maglischo, 2003).

In swimming, competitions are represented in 16 different types ranging from 50 m to 1500 m. These are considered to be short distances (100–200 m), medium-length ones (200 m and longer) and long-distance branches (400–1500 m and longer) (Aspenes & Karlsen, 2012) and it is thought that anaerobic processes are more dominant in swimming branches below 200 m (Marinho et al., 2011). Achieving superior performance in swimming, as in other sports, depends on the customization of trainings for young athletes (Wells et al., 2006).

Furthermore, in order to achieve good results especially in swimming races, such as short distances 50–100 m, many unified movements must be applied. Many features such as bio-motor features, force applied on the reaction time, the low resistance when entering the water, sliding under water and strong underwater thrust are the elements that need attention (Baydemir et al., 2019).

In the Olympic Games, which are used as a tool to achieve peace between people and countries, every athlete wants to compete, represents his/her country and become a champion. Since swimming is one of the first modern Olympic Games, it has gained more value every passing day. The degrees obtained and attention paid to swimming revealed the legitimacy of scientific studies conducted in this sport. Although swimming receives so much interest around the globe, it wasn't used to attract this much interest in our country, which is surrounded by sea on three sides, in the past compared to present time (Alp & Kılınç, 2015).

The heartbeat volume of swimmers is higher during exercise (Gökhan et al., 2011). There is a strong correlation between heart rate and MaxVO2. Accordingly, the value of MaxVO2 increases in swimmers during exercise (Ghosh et al., 1985).

In the light of literature within the study, we aimed to investigate the effects of sprint interval trainings on heart rate and 50 m swimming performances of young male swimmers.

2. Method

2.1 Participants

A total of 24 male swimmers attended to the study who are at least 5 years of sport age. Swimmers randomly divided into two groups as normal training group (NT, n = 12) and interval sprint training group (IST, n = 12). Swimmers' mean age was in NT 15.75 ± .45, in IST 15.58 ± .51 years; mean height was in NT 154.58 ± 6.78, in IST 158.16 ± 9.64 cm; mean weight was in NT 43.12 ± 7.49, in IST 45.95 ± 9.55 kg; mean BMI was in NT 18.02 ± 2.12, in IST 18.19 ± 2.29 kg/m^2. They joined to the study by having their parents confirm the "Parental Permission Form". We followed the principles outlined in the Declaration of Helsinki and the research was approved by ethics committee.

2.2 Measures and Tests

2.2.1 Measurement of Height

The height was measured by using a measuring tape on bare feet standing flat on the ground, heels joint, knees tense, and body straight position with 1 mm sensitivity. The values were recorded as "cm".

2.2.2 Measurement of Weight

The weight was measured by using a digital scale with as thin clothing as possible, and by using a digital scale with a sensitivity of 0.001 kg. The values were recorded as "kg".

2.2.3 Measurement of Heart Rate

The heart rate was taken by using a Polar RS-400 brand multi pulse control clock and chest strap. The heart rate values were recorded as the top and lowest rates in a distance range of 8 x 50 m interval repeats. Before the repeats values were recorded as "rested" (RHR) and right after the last interval repeat as "maximum" (MHR).

2.2.4 Swimming Performance Test

50 m degrees in crawl and backstroke styles have been recorded by using a Casio brand stopwatch with a precision value of 1/1000 second.

2.3 Procedure

As normal training group continued the routine swimming training, interval sprint trainings (8 x 50 interval repeats in crawl and backstroke styles) were applied to the IST group additionally for 8 weeks, 3 days a week, at least 30 min a day. 50 m sprint swimming tests in crawl and backstroke styles were applied to the swimmers in 1st and 8th weeks of the period.

2.4 Statistical Analysis

The analysis of data was made in the statistical package program by using "Descriptive statistics", "Paired t Test" and "Independent t Test" for comparison. The results were evaluated according to "0.05" significance level.

3. Results

Table 1. Paired t test results of NT group

	Test Sequence	Mean ± SD	t	p
RHR (beats/min)	Pre-test	71.16 ± 2.48	5.74	**.000**
	Post-test	69.41 ± 2.35		
MHR (beats/min)	Pre-test	181.83 ± 3.35	1.62	.133
	Post-test	179.33 ± 3.74		
Crawl (sec)	Pre-test	36.71 ± 3.95	5.02	.261
	Post-test	35.75 ± 3.02		
Backstroke (sec)	Pre-test	41.79 ± 5.67	7.24	.389
	Post-test	40.74 ± 5.80		

As shown in Table 1, comparison result of pre- and post-test values of NT, significant differences were found in RHR ($p < .05$), but insignificant differences found in MHR, Crawl and Backstroke performances ($p > .05$).

Table 2. Paired t test results of IST group

	Test Sequence	Mean ± SD	t	p
RHR (beats/min)	Pre-test	70.66 ± 2.60	7.34	**.000**
	Post-test	67.83 ± 2.16		
MHR (beats/min)	Pre-test	187.91 ± 3.17	7.12	**.000**
	Post-test	178.50 ± 3.42		
Crawl (sec)	Pre-test	36.03 ± 4.82	4.71	**.000**
	Post-test	32.59 ± 3.61		
Backstroke (sec)	Pre-test	41.49 ± 5.03	6.89	**.000**
	Post-test	37.86 ± 3.48		

When Table 2 was examined, comparison result of pre- and post-test values of IST, difference found statistically significant in RHR, MHR, Crawl and Backstoke performances ($p < .05$).

Table 3. Independent t test results of groups

	Groups	Mean	SD	t	p
1st week RHR (beats/min)	NT	71.16	2.48	.48	.635
	IST	70.66	2.60		
8th week RHR (beats/min)	NT	69.41	2.35	1.71	.101
	IST	67.83	2.16		
1st week MHR (beats/min)	NT	179.33	3.74	.56	.575
	IST	178.50	3.42		
8th week MHR (beats/min)	NT	181.83	3.35	-4.56	**.000**
	IST	187.91	3.17		
1st week Crawl (sec)	NT	36.71	3.95	1.30	.204
	IST	36.03	4.82		
8th week Crawl (sec)	NT	35.75	3.02	3.58	**.002**
	IST	32.59	3.61		
1st week Backstroke (sec)	NT	41.79	5.67	.82	.421
	IST	41.49	5.03		
8th week Backstroke (sec)	NT	40.74	5.80	2.44	**.023**
	IST	37.86	3.48		

Table 3 shows the comparison results between NT and IST groups. According to the comparison, significant differences were found in 8th week MHR, Crawl and Backstroke performances ($p < .05$); but differences were found insignificant in the other values ($p > .05$).

4. Discussion

This study was conducted to investigate the effects of sprint interval trainings on heart rate and 50 m swimming performances of young male swimmers. As a result of the analysis of comparison of NT pre- and post-test values, there was a significant difference in RHR, while MHR, Crawl and Backstroke values were not significant. We think that the reason for the difference in RHR is the positive effect of physical activity on the cardio-vascular system (adaptation). It was determined that there was a significant difference in RHR, MHR, Crawl and Backstroke when comparing the pre-and post-test values of IST. As a reason for the significant changes in physiological and swimming performance values, we can say that the training program we have implemented is related to the performance of the swimmers. In addition, we believe that endurance training, which is the reason for the improvement in heart rate and swimming performances, depends on the development of athletes in the cardiovascular system and the increase in endurance levels. In comparing between NT and IST group values, significant differences were found in the results of 8th week MHR, CRAWL, Backstroke. As a reason, we think that there is more improvement in performance values due to the content of interval sprint training program.

Koca (2003) gave swimming training for 3 months for a total of 54 people in their study including 11 women and 9 men who received swimming technical training; 9 women, 10 men swimming in the university team; 8 sedentary women and 7 men, who did not deal with any sports branch. At the end of the research; training male group resting heart rate was in pre-test 84.89 ± 3.22 beats/min, in post-test 83.33 ± 11.43 beats/min, swimmer male group was in pre-test 82.50 ± 10.80, in post-test 80.10 ± 8.71 beats/min. They found the values statistically insignificant. Turna et al. (2017) reported that positive improvements were observed in the swimming performances. They stated that sprint trainings have positiveimpacts on lactate levels and heart rates. Robergs and Roberts (1997) found the RHR averages of the elite swimmers as 56 ± 7 beats/min and the MHR values as 174 ± 8 beats/min in their research. Morrow et al. (2002) in their study, they found the resting heart rate value averages of the swimmers at the national team level to be 57.2 ± 4.2 beats/min, and the maximum heart rate value to 176 ± 3 beats/min. Gönener et al. (2017) aimed to investigate the effect of 8-week training on back swimming style 100 m performance in male swimmers aged 13–15. According to the results, a statistically significant difference was found as a result of comparing the pre- and post-test mean results of the experimental group.

In the study by Yapıcı and Cengiz (2015), the swimmers' swimming performance of 50 m was found to be 32.30 seconds on average. Girold et al. (2007) found 21 male swimmers' performance of 50 m in 31.35 sec with an average age of 16.5 years, while John et al. (1992) found their 50 m performance in 29.58 sec in 12 performance swimmers. Şenol and Gülmez (2017) determined 50 m swimming performances in the TRX group as 33.10 ± 2.95 and 32.43 ± 2.76 sec in the final test. In the control group, it was found that it was not significant as 36.28 ± 3.84 in the pre-test and 36.00 ± 3.73 sec in the post-test. Toubekis et al. (2006) performed interval swimming training for 3 months with the participation of 120 elite swimmers and stated that there was a positive change in swimmers' 50 m crawl swimming performances at the end of the study.

Günay (2007) in his study on 72 licensed swimmers in total 36 females and 36 males, examined the effects of swimming training on some physical and physiological parameters. The swimmers are divided into three groups as elite group, performance group and control group. Elite swimming group; 24 girls of 12 girls and 12 boys performed 6 swimming training sessions and 28 units of 144 training sessions as ground training for 24 weeks. Performance swimming group; 12 girls and 12 boys athletes did 5 swimming exercises for 24 weeks. The control group is; 24 students, 12 girls and 12 boys, did not participate in any physical activity for 24 weeks. As a result of this research; swimming performances have improved significantly compared to elite swimming group, performance swimming group and control group. Günay stated that regular swimming trainings constantly improve the athletes' degrees.

In a similar study of Selçuk (2013) on 11–13 age group swimming athletes, the changes in swimming performances of the groups were examined at the end of 12 weeks. The pre-test and post-test averages of 25 and 50 m freestyle swimming times of both groups were found to be statistically significant. At the same time, the group doing terebant and swimming training is more developed than the group that only swimming.

Koparan (1998) in a 10-week study conducted to investigate the effect of pliometric training on swimming performance with 20 male students aged 15–17, when the experimental group analyzed the pre-test and post-test values of 25 m free-style swimming times, results showed 10.05% improvement; the control group improved by 3.1%. In the second swimming distances, which is the sportive efficiency branch of the same study, the experimental group showed an improvement of 7.17%, while the control group showed an improvement of 3.2%. In this study, when the measurement results of 25 m swimming performances before and after training were examined, the female experimental group developed by 9.52%, the female control group developed by 3.97% and the male experimental group developed by 9.14%, the male control group 4% has improved by 13%.

Rejman et al. (2017) examined 6-week plyometric trainings on 9 male swimmers at the national level. According to the data in the study, they obtained statistically significant results in terms of the athlete's departure from the exit block, the airborne time, the gliding speed in the water and the angle of entry into the water. Bishop et al. (2009) investigated the effects of 8-week plyometric training on the start time in a similar study conducted with swimming club students aged 10–16. With the command to the athlete standing at the offset stone, they determined that the group performing swimming + plyometric showed more development than the swimming group as a result of measuring the time until the contact of the head with the water and the swimming time of 5.5 meters. These findings support the development of 15 m swimming time obtained in our current study. Hawley et al. (1992), in their study on 12 male and 10 female swimming students, determined significant changes for 50 m sprint swimming performance after 8 weeks of training. Özdoğru (2008) found statistically significant improvements in the swimming performances of the group who performed core training with swimming for 8 weeks on 60 male athletes aged 10–12.

5. Conclusion

To conclude, we could say that the reason of finding significant differences in RHR and MHR is the positive effects of physical activity on the cardio-vascular system (adaptation). And, the reason for the positive effects on sprint interval performance depends on sprint interval swimming which was acute origination of body's physiological reaction to rising energy need during short time and intensive physical activity even in micro plan. This is suggested for sports scientists that sprint swimming tests applied in macro-training may help longer-term observations in swimmers. Considering that physiological responses are the important factors to affect the performance, we think that the results of our work will contribute a reference value to the swimming coaches and swimmers in terms of performance monitoring. Our research offers advices to coaches and sports scientists in terms of training model, content and density to be selected in the studies to be conducted in the future.

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