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Does Rest Period After Warming Up Have an Effect on Swimming Performance?[1]

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Yücel İnaç* – Tülin Atan** – Şaban Ünver***
*Specialist, Ondokuz Mayıs University, Samsun/Turkey
E-Mail: inacyuce@gmail.com **ORCID:** 0000-0002-4093-1462
** Prof. Dr, Universty of Ondokuz Mayıs, Faculty of Sport Sciences, Samsun/Turkey
E-Mail: takman@omu.edu.tr **ORCID:** 0000-0001-5660-8910
*** Asst. Prof. Dr., Universty of Ondokuz Mayıs, Faculty of Sport Sciences, Samsun/Turkey
E-Mail: saban.unver@omu.edu.tr **ORCID:** 0000-0001-7378-596X

Abstract

The purpose of this study is to evaluate the effects of different rest periods after the warm-up (WU) done before a swimming performance.Eighteen licensed male swimmers in Samsun's swimming clubs who have been at least three years in active swimming and training with a minimum of 4 days a week; voluntarily participated in this study. After doing land and water WU, athletes rested 10 min, 20 min, 30 min or 40 min (on different days) before swimming performance. The swimming performance values of the athletes were measured at distances of 50m or 400 m. Each athlete had the test within eight separate days (resting 10 min, 20 min, 30 min or 40 min), with a total of 4 times 50 m and 4 times 400 m. The measurements were carried out at the Olympic swimming pool of Ondokuz Mayıs University. Statistical analysis of the collected data was done using the Friedman test and Wilcoxon sign rank test.Findings show that post-WU rest periods of 10 min, 20 min, 30 min and 40 min, did not have any significant effect on the 50 m swimming performance values of the athletes($p > 0.05$), while, a statistically significant effect ($p<0.05$) was found in performance values when the athletes applied the post-WU rest periods in 400 m swimming distance. Additionally, according to the rest periods post-WU, it was determined that there was no statistically significant difference between the heart rate (HR) values after a 50 m swimming distance ($p>0.05$), while it seemed to affect the HR values after 400 m distance ($p<0.05$).Rest periods post-WU do not affect the 50 m swimming performance. However, 40 minutes rest time post-WU enhances the 400 m swimming performance. Concurrently, a higher performance after a 40 min rest period results in higher HR values after a 400 m swimming. In conclusion, we conclude that post-WU rest time does not affect the 50 m and 400 m freestyle swimming performance. However, at 400 m swimming distances, increasing the rest time post-WU improves swimming performance.

Key Words: *Swimming, Warm-up, Rest Periods.*

[1] *This study was produced from the master's thesis titled "The effect of rest time after warn up on swimming performance".*

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Isınmadan Sonra Dinlenme Süresinin Yüzme Performansı Üzerinde Bir Etkisi Var mıdır?

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Öz

Bu çalışma yüzme müsabakası öncesi yapılan ısınmanın sonrasındaki dinlenme süresinin performans üzerindeki etkisini incelemek amacıyla yapılmıştır.Çalışmaya, Samsun'da bulunan yüzme kulüplerine lisanslı olarak devam eden ve en az 3 yıl aktif spor (yüzme) yaşantısı olan haftada en az 4 gün antrenman yapan 18 erkek yüzücü gönüllü olarak katılmıştır. Çalışmaya katılan sporcular araştırmacılar tarafından hazırlanan kara ısınması ve su içi ısınması yaptıktan sonra farklı günlerde 10dk, 20dk, 30dk veya 40dk dinlendirilerek, sporcuların rastlantısal şekilde 50 m veya 400 m yüzme performansları ölçülmüştür. Her sporcu 4 farklı günde olmak üzere toplam 8 kez (50 m ve 400 m) teste tabi tutulmuştur. Ölçümler Ondokuz Mayıs Üniversitesi Olimpik yüzme havuzunda gerçekleştirilmiştir. Verilerin istatistiksel analizinde Friedman testi ve Wilcoxon işaret sıra sayıları testi kullanılmıştır. Sporcuların ısınma sonrası 10dk, 20dk, 30dk ve 40dk bekleme sürelerinin 50 m yüzme performansı üzerinde istatistiksel olarak anlamlı düzeyde etkisi olmadığı (p>0,05), ancak 400 m yüzme dereceleri incelendiğinde dinlenme sürelerinin yüzme performansını istatistiksel olarak anlamlı düzeyde etkilediği tespit edilmiştir (p<0,05). Sporcuların ısınma sonrası dinlenme sürelerine göre, 50 m yüzme sonrası Kalp Atım Hızı (KAH) değerleri arasında istatistiksel olarak anlamlı farklılık olmadığı (p>0,05) fakat 400 m yüzme sonrası KAH değerlerini etkilediği tespit edilmiştir (p<0,05). Isınma sonrası bekleme süresi 50 m yüzme performansını etkilememektedir. Isınma sonrası bekleme süresi 40dk'ya çıkarıldığında; 400 m yüzme performansı artmaktadır. Bununla bağlantılı olarak, 40dk bekleme sonrası daha yüksek performans sergilenmesi, 400 m yüzme sonrası KAH'ının da daha yüksek çıkmasına neden olmuştur. Sonuç olarak, ısınma sonrası dinlenme süresi, 50 m'ye kadar olan kısa mesafe yüzme performansını etkilemez. Ancak yüzme mesafesi uzadıkça dinlenme süresinin de artması performansta iyileşme sağlamaktadır.

Anahtar Kelimeler: *Yüzme, Isınma, Dinlenme Süresi.*

Introduction

Warm-up is generally defined as the physical activity done before the main event and meant to prepare the athlete to perform and increase athletic performance (Hedrick, 1992, p.25). Nowadays, whether it is a sports activity for well-being, a performance sport or training for that sport, the first activity to encounter in a competition or training session is WU (Kuter and Ozturk, 1997, p.35). WU is considered one of the most crucial factors known to improve training and competition, leading to optimal athletic performance (Ballionis, Nepocatych, Ellis, Richardson, Neggers and Bishop 2012, p.485). The WU intends to enhance muscle and tendon mobility, accelerate blood flow and increase muscle temperature (Smith, 2004, p.13). During WU, activation and continuous movements of the muscle facilitate the transition from resting to exercise state. Additionally, pre-engaging muscles in WU activity reduces the risk of injury (Woods, Biskop and Jones, 2007, p.1090). With WU, athletes are prepared physically and psychologically in the most appropriate way that matches specified tasks, which eventually enhance the coordination of target-oriented movements (Sevim, 2007, p.296).

The WU intends to increase the body's temperature, especially within the muscles. Apparently, in events that start without proper WU, blood circulation decreases as a result of the vasoconstriction due to the low body temperature below 37° C (Gunay and Yuce, 2008, p.235). Resulting in decreases in the amount of nutrient carried to the tissues, which negatively affect athletic performance.

Swimming is a sport by which milliseconds counts when winning a race. Therefore, it is profound to identify specific factors that increase performance at each phase of WU, training, and competitions (Agopyan, Bozdogan, Tekin, Yetkin and Guler, 2012, p.494). As in different sports branches, WU is the first work to be done when seeking to increase swimming training and performance.

Scientific research has proven that pre-competition WU has an effect on performance. However, reviewing the literature of swimming research, no study or any source of knowledge has been observed to examine the length of post-WU rest time and its positive impact on swimming performance. Therefore, we can say that this study is peculiar in this respect. The aim is to resolve gaps in the literature and provide athletes and coaches with critical

information. Furthermore, it can guide investigators in this area for future research. The purpose of this study to examine the length of different rest period post-WU & their impact on swimmers' performance is substantial.

This study was designed with the hypothesis of how different rest periods after warming up in swimming will reflect on performance. Considerably, in most competing conditions, athletes are given a specific duration to first WU for once in the same pool where the competition is running. In such circumstances, where there is no spare WU pool where the competition is taking place, swimmers after their WU have to wait outside the pool until race time before entering the water again. We examine the implications of this situation on performance in this study and evaluate different rest periods post-WU influence on swimmers' performance.

Material and Method

Subjects: Eighteen male trained swimmers licensed for at least three years between 13 and 15 years of age volunteered to participate in the study. The participants trained at least four times a week during the duration of this study and had been involved in competitive swimming tournaments with national championships of Samsun province in Turkey. The study was conducted following the rules of Ondokuz Mayıs University KAEK 2018/349 ethics committee.

Study Design*:* Familiarizing the athletes with the devices used in the study and giving them the necessary information about the measurement processes, was ensured before starting the study. Athletes participated in trial measurements on a different day before the actual test day to assure obtaining reliable results from the measurement processes and to eliminate the fatigue factor of the subjects. The study measurements were carried out at the Olympic swimming pool of Ondokuz Mayıs University. The participants' physical characteristics such as age, height and body weight values were collected. The study design is given in the flow chart below.

Step 1	Step 2	Step 3	Step 4	Step 5
Land Warming Training (15min)	Water Warm Up Training (One of the following warm-ups will be applied for each measurement)	10min/20min/30min or 40min rest	Performance Measurement (50 m and 400 m swimming)	Heart Rate Measurements After Swimming Performance
* 4 laps of light tempo run around a 50x25 m pool * Burpee (10 Times) * Squat (10 Times) * Mountain Climbs Forward/Backward arm movements	**Warm-up before 50 m freestyle swimming performance: (15min)** * 200 m freestyle swimming 45sec rest * 2x100 m (25 m foot / 50 m right-left arm drills / 25 m freestyle) 45sec rest * 4x50 m (25 m fast / 25 m slow free swimming) 45sec rest * 100 m cooling float **Warm-up before 400 m freestyle swimming performance: (25min)** * 300m freestyle swimming 45 seconds rest * 2x100m (25 m foot / 50 m right-left arm drill / 25 m free swimming) 45sec rest * 4x100 m fast free swimming 2 minutes rest 100 m cooling float	The athletes rested for the specified time before performance	The athletes swam the determined swimming distance (50 m / 400 m) at the end of the rest period and their performance values were recorded in terms of total time.	Heart Rate measurements were recorded immediately after the athletes' swimming performance of 50 m / 400 m.

Figure 1. Flow chart of the study

Note: *For this study, an athlete performed 4 times 50 m (10 min / 20 min / 30 min and 40 min rest), 4 times 400 m (10 min / 20 min / 30 min and 40 min rest) on different days.*

Statistics*:* SPSS 21 package program was used in the statistical analysis of the data. The Shapiro Wilk test was used to check whether the data showed normal distribution. Since the data did not show a normal distribution, the Friedman test was used to examine the differences between swimmers' performance values measured after four different resting periods. The Wilcox-

on sign rank test was used to determine which resting times have shown any difference.

Results

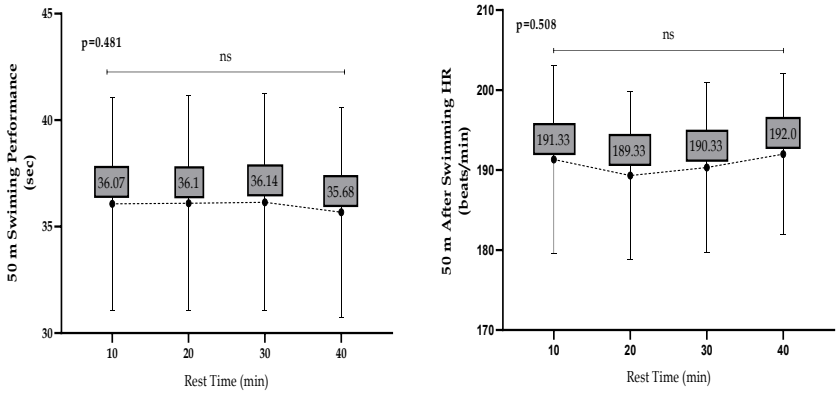

Figure 2. 50 m swimming performance values and HR values after different rest periods
ns = non-significant, **min =** minute, **sec =** second, **HR =** Heart Rate, **m =** meter

The 50 m (duration) swimming performance according to different rest periods (10 min, 20 min, 30 min, 40 min) and HR values after this performance are presented in Figure 2. It was found that post-WU rest periods of 10, 20, 30 and 40 minutes did not have a statistically significant effect on the 50 m swimming performance ($p>0.05$). It was found that there was no statistically significant effect on HR values measured after swimming ($p>0.05$).

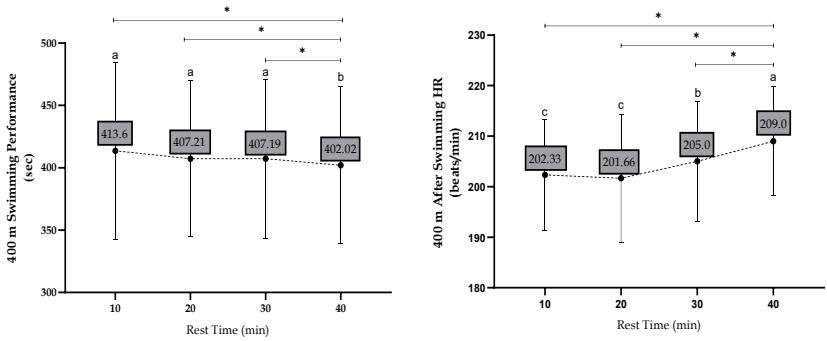

Figure 3. 400 m swimming performance grades and HR values after different rest periods

**** p <0.05, min = minute, sec = second, HR = Heart Rate, m = meter***

Figure 3 shows the swimming performance of 400 m (duration) according to different rest periods (10 min, 20 min, 30 min, 40 min) and HR values after this performance. When the 400 m swimming measurements were examined after different rest periods, it was determined that the rest period had a statistically significant effect on the 400 m swimming performance ($p<0.05$). When swimmers were given a 40 minutes rest period, they showed better performance than the other resting periods ($p<0.05$). Additionally, a statistically significant difference was found in HR values measured after 400 m swimming performance post different rest periods ($p<0.05$). It was determined that the HR values measured after 400 m swimming performance resting 40 minutes post-WU were statistically significantly higher than the HR values measured after the performance after all the other rest periods (10 minutes, 20 minutes and 30 minutes) ($p<0.05$). Likewise, it was determined that the HR values measured after the 400 m swimming by resting for 30 minutes post-WU were statistically significantly higher than the HR values measured after the performance of 10 and 20 minutes rest ($p<0.05$).

Discussion, Conclusion and Recommendation

The purpose of this study was to examine the effect of rest periods (10 min, 20 min, 30 min and 40 min) post-WU before the swimming performance (50 m and 400 m).

50 m and 400 m swimming performances (duration) and HR values measured after swimming; were compared according to post-WU rest periods of the subjects. It was found that different post-WU rest periods before swimming, did not have a statistically significant effect on the 50 m swimming performance and HR values. In other words, after all different rest periods post WU, 50 m swimming performance and the HR values measured after this performance were similar to each other.

Since 50 m swimming is a short distance, rest periods may not affect short distance swimming performance. This finding of our study was supported by another study found in the literature (Turkmen, 2019, p.35). In another attempt to determine the effects of different time intervals on repetitive swimming performances post-WU, a study evaluated the contribution of active rest types performed during these periods. Participants were nine active swimmers involved in competitive swimming and continuous training with an average age of 16. The study determined no significant statistical effect of rest periods on performance. However, it has been stated that the most effective rest interval in terms of repetitive swimming performance is 30 minutes, with the fact that swimmers stop warming up 30 minutes before the start of the competition may have positive effects on performance (Turkmen, 2019, p.35).

Since there are no studies similar to ours in the literature, we examined studies investigating the effect of resting time post-WU from different branches (Galazoulas and Tzimou 2012; Alber and Annoni, 2014; Coskun, 2017). One study examined the effects of rest periods of 4, 8 and 12 minutes on vertical jump performance. It concluded that performance was higher after 4 minutes of rest when compared to 8 and 12 minutes of rest periods (Ryan, Lowery, Nevine, Duncan and Jeremy, 2012, p.3320). Similarly, a study conducted by basketball players examined passive rest intervals of 10, 20, 30 and 40 minutes post-WU. Found a decrease of approximately 15% in the jumping performance of the athletes in the 20th minute. In the same study, the author reported that the group standing without doing any activ-

ity during the 20-minute rest period post-WU had better jumping performance than the group that did inactive sitting (Alberti, Annoni, Ongaro, Scurati and Michielon, 2014, p.85). In another study that observed a gradual decrease in athletes' jumping performance, the author referred that after 40 minutes of passive rest, there was a 20% decrease in jumping performance and a 6% decrease in sprint performance (Galazoulas, Tzimou, Karamousalidis and Mougios, 2012, p.30). The findings of these studies that examined athletes jumping efficiency are different from the results of this study. The reason for the different results is thought to be due to the difference in the measured motor feature.

As determined in this study, the resting time post-WU had a statistically significant effect on both the 400 m swimming performance and the HR values measured afterwards. Besides, increasing the resting time up to 40 minutes is thought to have a distinguished effect on performance due to the more time allowed to remove LA formed in the muscles after WU. According to Sahlin (1992, p.99), the recovery time from the maximum lactate concentration to the standard levels is 30-60 minutes. In our study, the subject completed 15 minutes on land and 25 minutes in the pool water, a total of 40 minutes WU pre-starting the 400 m swimming performance. That may cause the subjects to get tired and increase the amount of LA. Obviously, after 40 minutes rest period post-WU, LA amount will further reduce than from a 10 min rest. Ensure enough time for the body to rest and even perform better. In a previous study it was reported that the maximum blood lactate concentration value reached 10.0±1.25 mmol/L after a test and dropped 2.87±0.91 mmol/L after 60 min posttest. A study considered the difference in LA concentration as the indicator of the participants' rate of removal of lactate from the blood. The average rate of lactate elimination per minute (recovery rate) for 1 hour after loading was 0.12 ± 0.03 mmol/L. As a result, the best time to start a second activity can be considered with lactate levels of 2.5 mmol/L post-WU. In accordance to mean values, the athletes are thought to return to a base value within one hour. In the literature, the time to reach this level is generally reported to be between 30 and 60 minutes (Rahmini, 2005, p.362).

As the post-WU rest period increased, the HR values increased too after the 400 m swimming performance. The longer the rest period of the subjects' post-WU allowed for more effort to be exerted and eventually enhance

their performance in the 400 m. Thus, estimating that the higher HR values are related to higher effort exertion. These results serve to confirm earlier findings by Gouvea at al. They examined the effect of different rest period in the range of 0 to 16 min on the vertical jump. In their study, up to 0-3 minutes of rest was found to decrease performance, and a period of 3-12 minutes had moderate effects, whereas an increase in performance has been observed when resting time increased up to 16 (Gouvea, Fernandes, César, Silva and Gomes, 2013, p.460).

Considering similar studies in the swimming literature, in Zochowski, Johnson and Sleivert (2007, p.203) study conducted of 5 female and 5 male subjects a total of 10 national team-level swimmers with an average age of 17, they found that a 10-minute passive rest interval post-WU protocols were more effective than 45 minutes. They stated that 200m swimming performance records were 1.48% higher. Similarly, West, Dietzig, Bracken and Cunningham (2013, p.175) observed an increase of 1.48'% when they compared periods of 20 minutes and 45 minutes of passive rest on a 200m swimming performance. Besides these two studies, when Neiva, Marques, Barbosa and Izquierdo (2017, p.82) examined 11 male swimming athletes with an age range of 16-18, the determined a 1.12% improvement in 100 m free sprint performance after 10 minutes than 20 minutes of passive rest interval post-WU. The findings of these studies contradict the results of this study. That may be due to the age differences, the shorter training experience of the subjects in our sample group or the difference in swimming distance.

Different rest periods between 10-40 minutes post-WU do not affect the 50 m swimming performance. However, this situation differed when the swimming distance is longer. In other words, when the resting time after warming is increased to 40 minutes; 400 m swimming performance is increased. Accordingly, a higher performance resulted in a higher 400 m post-swimming HR. In conclusion, post-WU rest time does not affect swimming performance short distances up to 50m. However, as the swimming distance increases, a longer rest period has shown to improve performance.

Twenty male athletes between the age of 13 and 15 years old voluntarily participated in the study. Future studies can investigate the performance of swimmers of higher age groups. It might be better to investigate the effect of

resting periods on performance by dividing them into more specific intervals.

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