

Acute Effect of Static Warm-up Duration on 50 Meter Freestyle and Breaststroke Performance*

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Abstract

Objectives: The purpose of this study was to determine the acute effect of different static warm up durations on sub-elite female swimmers on 50 m freestyle and breaststroke swimming performance.

Methods: Ten sub-elite women swimmers (age 22.46 ± 2.64 years, body height $163,4 \pm 4.27$ cm, body weight 56.39 ± 9.72 kg, BMI 21.09 ± 3.27 kg/m² and BFP 21.77 ± 8.06 %) were assigned randomly to 3 different warm-up protocols on non-consecutive days. The warm-up protocols consisted of only 5 minutes of jogging (No Warm-up), 5 minutes of jogging and 30 seconds static warm up (30-SS), 5 minutes of jogging and 60 seconds static warm up (60-SS). Following each morning (10.00) warm-up session, participants were tested on the 50 m freestyle and breaststroke swimming performance. Warm up protocols (NWU, 30-SS and 60-SS) were compared by repeated measures analyses of variance (ANOVA).

Results: Based on the results of this study, it was found that there are significant differences between NWU and SS-30, SS-60 on freestyle and breaststroke swimming performance (freestyle $p=.000$, $p=.014$ and breaststroke $p=.005$, $p=.000$ respectively). When the 30-seconds and 60-second warm-up protocols were compared with each other, a statistically significant difference was found in favor of the 30 seconds warm-up protocol in freestyle and breaststroke 50 m swimming performance ($p=.001$ and $p=.003$ respectively).

Conclusion: Swimmers shouldn't prepare with static warm up protocols before 50 m freestyle and breaststroke swimming competition. However, there is still a need for studies investigating the effect of different types of warm up protocols on different distance swimming performance scores in the future.

Key Words: Static, Warm Up, Performance, Sub-elit

Introduction

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Good swimming performance can be influenced by training, genetics, and opportunity, and also by a “warm up” (WU), recognized as an important factor in athletic performance. Warm-up before swimming is defined as engaging in physical activity before the main event for the purpose of improving swimming performance (Bobo, 1999; Balilionis et al, 2012). Warm up protocols before training or competition has become one of the most important topics for coaches and practitioners and recent studies has shown some positive effects on performance (Fradkin et al, 2010; Neiva et al, 2014). For decades, practitioners have prescribed warmups to prevent injuries, improve range of motion, decrease muscle soreness and enhance the performance of their athletes (Alter, 1998; Bishop, 2003; Moran, 2013; Neiva et al, 2014). Additionally, the hyperthermia induced by warm-up leads to vasodilatation and increased muscle blood flow, most likely resulting in optimized aerobic function due to the higher oxygen consumption during subsequent tasks (Gray and Nimmo, 2001; Neiva et al, 2014). Muscle temperature improves the efficiency of muscle glycolysis and high energy phosphate degradation during exercise, which may be from increasing the dependence on anaerobic metabolism and also markedly influence subsequent exercise performance via increases in adenosine triphosphate turnover, muscle crossbridge cycling rate and oxygen uptake kinetics, which enhance muscular function. (Febbraio et al, 1996). There are lots of warm up protocols as static, dynamic, PNF, in water and dry land. Static warm up, which is one of them, usually involves keeping the joint in the extended position for 15 to 60 seconds until the end of the range of motion (Young ve Behm, 2002). Static warm up has been shown to be an effective means of increasing range of motion (ROM, Power et al., 2004). Since many years static warm up has been regarded as an important component to improve performance (Young and Behm, 2002). Recently, many studies have reported that moderate-level stretching (15-30 seconds per muscle group) does not affect short-term muscle strength (Cramer et al., 2007; Ogura et al., 2007). Conversely, work performed on 30 seconds static, 60 seconds static, 90 seconds static resulted in reduced jump height (Winchester et al., 2008; Robbins and Scheuermann, 2008). In the same context, other studies have shown that static warm up negatively affects strength, speed and jump performance in a competition (Chaouachi et al., 2010). Prior to competitive warm up protocols are one of the necessary components to optimize performance in athletic competitions. For this reason, it is considered that the swimmers can reach the most appropriate fitness level (such as strength, speed, quickness, durability) during the competition by means of warm up protocols and the warm up period. Therefore, the warm-up period before the competition are extremely important for

reducing the risk of injury and efficient performance. The aim of this study was to investigate the acute effect of different static warm up durations on sub-elite female swimmers on 50 m free and breaststroke swimming performance.

Method

Participants

Ten sub-elite women swimmers (age 22.46 ± 2.64 years, body height 163.4 ± 4.27 cm, body weight 56.39 ± 9.72 kg, BMI 21.09 ± 3.27 kg/m² and BFP 21.77 ± 8.06 %) were assigned randomly to 3 different warm-up protocols on non-consecutive days. The study was conducted only on the study group and there are no control groups in the study. The volunteers were given a trial run before their research and measurements, and a day later research was carried out on different days that did not follow each other. Different warm up protocols applied to the volunteers were performed at 10:00 am. All participants were informed about possible risks and details before commencing work and a voluntary consent form was signed by the participant. The study was approved by the Malatya Clinical Research Ethics Committee.

Warm Up Protocols

No Warm Up (NWU): Warm up protocols consisted of 5-minute low- intensity jog with a polar clock running at 140 beats/min. After 3 minutes of rest, while subjects' pulses were between 110-120 beats/min, the swimming performances of the sub-elite swimmers were measured at 50 m in different styles.

Static Stretching-30 (SS-30): Warm up protocols consisted of 5-minute low- intensity jog with a polar clock running at 140 beats/min. After 3 minutes of rest, while subjects' pulses were between 110-120 beats/min, they performed 30 seconds static warm up (each one only one limb). After subjects' pulses were between 110-120 beats/min, the swimming performances of the sub-elite swimmers were measured at 50 m in different styles.

Static Stretching-30 (SS-60): Warm up protocols consisted of 5-minute low- intensity jog with a polar clock running at 140 beats/min. After 3 minutes of rest, while subjects' pulses were between 110-120 beats / min, they performed 60 seconds static warm up (each one only one limb). After subjects' pulses were between 110-120 beats/min, the swimming performances of the sub-elite swimmers were measured at 50 m in different styles (Alter, 1988; Faigenbaum et al., 2005, Costa et al., 2009; Gelen, 2010).

Table 1. Static warm up content

Static Warm up Exercises	Implementation of Static Warm Up Exercises
Triceps Stretch	The flexed arm is applied by being pressed downward by the other hand.
PectoralStretch	The arm at the fixed position should not be twisted from the arm elbow by holding it in the opposite direction.
LatissimusDorsive PosteriorDeltoidStretch.	The hands are joined on the head without bending the elbows.
BicepsStretch	The arms are extended backwards without bending the elbows.
Adductor stretch.	While being seated on the ground the subject bends both legs putting both feet together. After that the knees are lowered sideways as far as possible with the help of the elbows.
Modified hurdlers stretch	In a seated position with one leg straight, place the other leg on the inside of the straight leg and reach forward.
Hip rotator stretch.	The subject lies on his/her back, with both knees bent and feet flat on the floor. The ankle bone of the left leg is rested on the right thigh just above the knee. The left knee is pushed downward until a stretch is felt in the hip. The same procedure is repeated for the opposite leg.
Bent-over toe raise	From a standing position with the heel of one foot slightly in front of the toes of the other foot, dorsiflex front foot towards shin while leaning downward with upper body
Quadriceps Stretch	The subject stands and touches a wall or stationary object for balance. The top ankle or forefoot is grasped from behind and then pulled toward the buttocks. The hip is then straightened by moving the knee backward and held in this position. The same is repeated for the opposite side.
Calf stretch	The subject stands straight on both feet at a 2-step distance from a wall, 1 leg is stretched in its place while taking a step forward with the other leg, using both hands on the wall for balance. Care must be taken not to lift the heels of the stretched foot off the ground. The same process is then repeated for the other leg.

Statistical Analysis

All the tests were stated as mean \pm standard deviation (mean \pm Sd). Conformance of the data to the normal distribution assumption was made by the Shapiro Wilks test. 'Repeated Measures of ANOVA' test was performed within the General Linear Model analysis method for the repeated 3 different measurements of normal distribution data. LSD was used in posthoc tests to find out which measure was derived from the difference. In the analysis of the data, the SPSS 17.0 statistical program (SPSS Inc, Chicago, IL) was used and the statistical significance level was accepted as $p < 0.05$.

Results

Table 2 shows the effect of static warm up protocols with different durations obtained from research subjects on freestyle and breaststroke swimming performance.

Table 2. Freestyle and breaststroke swimming performance values of static warm up protocols with different durations.

Performance Style (N = 10)	NWU	SS-30	SS-60	p	Bonferroni	Post hoc p
Freestyle (50 m)	29.72±.45	30.20±.28	31.60±.20	.000	1<2	.000*
					1<3	.014*
					2<3	.001*
Breaststroke (50 m)	41.96±.02	42.84±.27	43.80±.28	.000	1<2	.005*
					1<3	.000*
					2<3	.003*

(*: p<0.05)

According to Table 2, it was seen that the effect of the 3 different warm up protocols applied by the female swimmers before the 50 meter freestyle and breaststroke swimming performance effect swimming performance. The 50-meter freestyle and breaststroke style swimming scores measured without warm up were statistically significant (p = .000, p= .014, and breaststroke p = .005, p = .000, respectively) when compared to the other two other static warm up protocols. When compared with the 30 seconds static warm up protocol applied to female women and the 60 seconds static warm up protocol compared to each other, 30 second warm-up protocol was found to be statistically significant in favor of 50-meter freestyle and breaststroke style performance (p = .001, p = .003).

Discussion and Conclusion

This study was conducted with the participation of 10 volunteer female swimmers who were aged between 19-30 years in order to determine the acute effect of static warm up protocols applied to female swimmers on 50 m freestyle and breaststroke swimming performance. Measurements made by the same subjects after 48 hours of different warm up protocols, it is aimed to determine which warm up protocol is more efficient for swimming, according to the variations in 50 m swimming performance. After 3 different warm up protocols at 50 m swimming performance, there was a significant difference in the level of p<0.001. When the warm up protocols were examined, the best 50 meter freestyle and breaststroke style swimming performance was determined in warm up I (no warm up) phase. Our results demonstrated that SS-30 and SS-60 caused statistically significant deleterious impacts on 50 m freestyle and breaststroke swimming performance. Many studies have reported that acute passive static warm up induces significant reductions in force generation at low speed, moderate intensity and high speed (Behm et al., 2001; Brandenburg, 2006; Cornwell et al., 2002; Cramer et al., 2007; Viale et al., 2007;). Silva et al. demonstrated that SS and PNF caused statistically significant deleterious impacts on swimming performance

as evaluated by time taken to complete a 50 m front crawl swimming sprint test. Samson et al. (2012) were determined the effects of static and dynamic stretching protocols within general and activity specific warm-ups in nineteen subjects. They realized that the use of static stretching within an activity specific warm-up to ensure maximal range of motion along with an improvement in sprint performance. Faigenbaum et al. (2005) examined the acute effects of different warm-up protocols on fitness performance in children. The warm-up protocols consisted of 5 minutes of walking and 5 minutes of static stretching, 10 minutes of dynamic exercise (DY), or 10 minutes of dynamic exercise plus 3 drop jumps from 15-cm boxes (DYJ). They indicated that that vertical-jump performance declined significantly following static stretching as compared to DY and DYJ. Fletcher ve Jones (2004) investigated the effects of four different warm-ups on 97 rugby union players on 20m. sprint performance. These are passive static stretching, active dynamic stretching, active static stretching, static dynamic stretching. They reported that While static stretching applications decreased the short sprint performance. Vetter (2007) investigated the effects of six different warm up protocols on sprint and vertical jump performance in 14 men and 12 women. He found that there were no significant differences among the 6 protocols on sprint run performance. He indicated that a warm-up including static stretching may negatively impact jump performance. Yıldız et al. (2013) examined the acute effects of different times (15, 30 and 45 sn) of static stretching on sprint performance. Following low-intensity aerobic exercise, static stretching for 15 second duration, static stretching for 30 seconds duration, static stretching for 45 second duration and only low-intensity aerobic exercise (control-all without stretching) methods were used. The result of the study showed that static stretching, intended for lower extremity muscles, reduced sprint performance of athletes. It was observed that as the time of static stretching increased, sprint performance decreased. Their results have got negative effects of static warm up like our study. This phenomenon may be due to static warm up exercises leading to an acute decrease in the viscosity of tendon structures, thereby causing the muscle fibres to slide with reduced efficiency during movement (Kubo et al, 2001). Stretching exercises may also increase muscle compliance, which can limit the amount of cross-bridges and thereby reduce the ability of the muscle to produce strength (Wilson et al., 1994). Moreover, stretching appears to promote reduced intraspindle fibre activation due to a reduction in excitability of the α -motor neurons (decrease in reflex sensitivity) (Fowles et al., 2000). During static stretching, an increase in intracellular Ca^{++} concentration occurs and is correlated with a reduction in maximal contraction tension (Armstrong et al., 1993). All of the above

phenomena may be activated by muscle stretching and could act directly on the neuromuscular system, thereby compromising swimming performance, particularly in tests requiring immediate activity. Some limitations may impact the final finding of this study. The subjects' body temperature wasn't measured, and hormone levels, circadian rhythm of swimmers and meal times were not controlled during data collection. Accepting the limitations imposed by the method, this study concludes that acute SS-30 and SS-60 reduce freestyle and breaststroke swimming performance. In particular, when the findings of swimming performance were examined in terms of the duration of static warm up, the increase in static warm up time was determined by research results that would further adversely affect swimming performance.

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