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Impact of static stretching warm-up on 100-metters front crawl performance: A comparative study

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Abstract
The purpose of the study was to examine the effect of static stretching warm-up and water warm-up techniques on the performance of male swimmers, with a focus on the 100-meter front crawl. Fifteen male swimmers, ranging in age from 18-23, with a competitive experience in national-level events and at least five years of training, were chosen for the study. Using a counterbalance design, each participant went through two trials of static stretching and water warm-up with a 48- hours break between trials. The swimmer's performance in 100-meter front crawl was painstakingly tested under various water warm-up. Using descriptive statistics and paired stats, our result revealed no significant difference in 100-meter swim performance between the different warm-up techniques. The mean times were 66.1133 seconds and (S. D=1.68456) 65.7533 seconds (S. D=1.67008) respectively. The results suggested that the static stretching as part of a warm-up protocols, does not have a significant impact on the swimmers' performance in the 100-meter front crawl. Limitations include the small sample size and the use of a 25-meter pool, which may limit the generalizability of the results.

Keywords: Static stretching; swimming performance, 100-meter front crawl, warm-up technique, athletic performance, counterbalance trial

Introduction
The notions of sports performance and competitiveness are closely connected in the field of athletics, since they encompass the physical, psychological, and tactical elements demonstrated by individuals and teams in competitive settings. (Khare, Reddy, Kumar, & Sisodia, 2023) [5]

Before engaging in physical activity, warm-up techniques have been utilised to get athletes ready for the task at hand. Numerous coaches have selected these treatments because it is believed that they will lower the chance of injury, explosive strength (Nandal & Kumar, 2024) [4] increase range of motion, and lessen pain in the muscles. However, as information on stretching techniques and kinds has grown over time, many coaches have begun to distort the way athletes should warm up and improperly employ stretching during the warm-up. Stretching the right muscles is crucial, especially those that will be working hardest during the length of the exercise. Although several studies have already looked at the optimal types of stretching, none have been established to prove how stretching before swimming affects performance.

Performance is facilitated by greater muscular temperature, it was hypothesised that temperature may improve performance by causing a decrease in the viscous resistance of muscle, accelerating rate-limiting oxidative processes, (Kumar, Khare, & Sisodia, 2021) [2] or increasing oxygen supply to muscles. Muscle blood vessel vasodilation is associated with improved performance. (Jadaun, Kumar, Singh, & Sisodia, 2021) [3]. Improved temperature also causes vasodilation, which enhances blood flow to the muscles. (King J. B., 1909) [1]

Stretching is another technique coaches utilise as part of regular conditioning. Many, if not all, coaches would work to help their athletes develop the flexibility needed for the rigours of their sport. Stretching is frequently done as part of the warm-up pre and post any specific warm-up and as cool-down processes following an activity or workout. The employment of stretching techniques raises distinct questions regarding the optimum approach to adopt for each. These three stretching techniques each bring their own set of questions on which one is the best to adopt in order to improve performance. (Armagan Kafkas, 2019) [7]

Static stretching was often done before to activity in the past. Static stretching is maintaining a stretched posture only with the power of your muscles, such as keeping your leg out in

front, to the side, or behind you. The hardest flexibility to achieve is static-active flexibility, which needs a lot of strength.

This study aims to explore the effects of static stretching warm-up techniques on swimmers. Specifically, it is investigating the impact of these techniques on the performance of swimmers in a 100-meter front crawl.

Materials and Methods

Selection of the subjects

For the study, a total of 15 male swimmers was purposively selected. The inclusion criteria were:

a) Players falling in the age range of 18 to 23 years.
b) Players who have participated at national level tournaments.
c) Players who had at least 5 years of training experience.
d) Players who are free from any sort of injuries / mental illness that can affect the data collection process.

Criterion Measures

Performance of swimmers was measured for 100mt. front crawl under the different warming-up and stretching conditions.

Validating

The participants were assigned conditions with warm-up protocols: Static stretching and swimming. The warm-up procedure for that particular day was executed as shown in the warm-up protocols section. Upon completion of the warm-up procedure, participants were given rest and their pulse rate was recorded by carotid pulse method, before being placed into time trials. Each swimmer then had to swim 100meter sprint in 25meter pool. For each of these swims, participants were instructed to swim using only front crawl. All the timings were recorded to the nearest hundredth of a second and for that stopwatch was used. The record of first 50meter split timings will also be recorded and a total of 100 meter. All the participants had complete three trials in counter balanced manner with the gap of 48 hours between each trial.

Stretching protocol

The static stretching procedure includes nine stretches that each participant was to be complete. Each stretch was held at mild discomfort for 30 seconds, rest for five seconds, and then complete the same stretch again for another 30 seconds. The nine types of static stretches are shown in table below:

Table 1: Shows static stretching protocol.

Hip and Lower back	In a seated position with one leg extended, cross the other leg over the extended leg; wrap arms around crossed leg and pull towards chest.
Quadriceps	While lying on your side with body erect, bend top knee and hold the foot with one hand while pulling foot towards buttocks.
Hamstring Stretch	In a seated position with both legs extended straight out, grab the legs with hands and extend upper body as far forward as possible.
Calf Stretch	In a standing position with feet staggered about 2-3 feet from a wall, place both hands on wall and lean forward; keep the back leg straight with heel to floor and the front leg slightly bent.
Chest	In a standing position, place both arms behind the back, clasp hands together and lift arms upwards.
Horizontal Flexion I	With a straight elbow, thumb pointed upwards and the palm facing the body, exhale and reach arm towards top of opposite shoulder. Use the opposite hand to assist at the end of the elbow.
Horizontal Flexion II	Reach around to opposite side of neck. Place hand on top of shoulder, raise elbow to shoulder height without elevating shoulder of arm. Walk fingers down the upper back as far as possible.
Hyperextension	Singe Arms With palms facing upwards, reach both arms backward as much as possible and have a partner extend the arms upwards.
Triceps	With elbow flexed at 90 degrees in front from vertical position, move flexed arm as far upwards as possible.

Table 2: Participants activity chart.

Duration	DAY 1	DAY 2
15-20 min.	Static stretching	Water warm-up
15-20 min.	Water warm-up	Static stretching
20 min.	20 MIN REST INTERVAL	20 MIN.REST INTERVAL
2 min.	TIME TRAILS	TIME TRIALS

Statistical Analysis

To analyse the data Mean, Standard deviation, and paired t-test was used to determine whether there is significant difference between the mean of groups.

Results

Table 3: Descriptive Statistics

Paired Samples Statistics			
	Mean	**Std. Deviation**	**N**
Pre-warm-up s.s	66.1133	1.68456	15
Post-warm-up s.s	65.7533	1.67008	15

Table 3 indicates the descriptive values of 100m swim performance at warm-up protocols wherein, the Mean and SD at Static Stretching & Water Warmup are 66.1133 & 1.68456; & at Warmup & Static Stretching are 65.7533 & 1.67008; respectively.

Table 4: Paired Samples Test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pre_warmup_ss - post_warmup_ss	.36000	2.49659	.64462	-1.02257	1.74257	.558	14	.585

Table 4 indicates that the value of Paired Samples 'T' Test test statistic was insignificant for the scores of 100m swim performance at various warm-up protocols as the p-value is greater than 0.05 level of significance i.e., p=.585. So, in this case, it can be asserted that the assumption of Sphericity is considered to be fulfilled. Therefore, the researcher employed the test of Paired Samples 'T' Test.

Discussion on Findings

This study set out to explore the influence of static stretching warm-up techniques on the performance of male swimmers, particularly focusing on the 100-meter front crawl. With a sample of fifteen male swimmers aged 18-23, each with significant competitive experience, the research employed a counterbalance design, allowing each participant to undergo two trials of static stretching and water warm-up, with a 48-hour break between trials. Utilizing descriptive statistics and paired t-tests, the study revealed no significant difference in 100-meter swim performance between the various warm-up techniques. The findings of this study contribute significantly to the ongoing discourse surrounding the efficacy of static stretching in warm-up routines for swimmers. Traditionally, static stretching has been widely embraced as a pre-exercise regimen with the belief that it enhances flexibility and reduces injury risk. However, recent studies, including those referenced herein, have cast doubt on its effectiveness, particularly in activities requiring explosive power and speed, such as swimming. The study suggests that static stretching may not confer additional benefits to swim performance, echoes the sentiment of previous research. (Armagan Kafkas *et al*. 2019) [7] investigated the effects of different stretching protocols on 50-meter swimming performance in sub-elite women swimmers, providing insights into the diverse impacts of warm-up strategies in swimming. (Thomas Zochowski *et al*. 2007) [6] sheds light on the importance of post-warm-up recovery time on swim performance, underscoring the multifaceted nature of optimizing warm-up routines in competitive swimming. It's crucial to note the limitations of the study, including its small sample size and the utilization of a 25-meter pool, which may impact the generalizability of the findings. Future research endeavours should aim to address these limitations and explore alternative warm-up strategies, such as dynamic stretching or specific swim drills, to enhance performance outcomes in competitive swimming events.

Conclusion

This study provides valuable insights into the potential impact of static stretching warm-up techniques on the performance of male swimmers, specifically in the context of the 100-meter front crawl. The findings indicate that there was no significant difference in swim performance Pre and Post static stretching warm-up and water-based warm-up protocols. These results challenge the conventional wisdom surrounding the efficacy of static stretching as a pre-exercise routine for swimmers. While static stretching has long been presumed to enhance flexibility and reduce the risk of injury, particularly in activities like swimming, where full range of motion and muscle elasticity are crucial, its direct influence on performance remains uncertain. Moreover, the implications of the findings extend beyond the scope of this study. They underscore the need for a nuanced understanding of warm-up strategies in competitive swimming and the importance of evidence-based practices in athletic preparation. Coaches and athletes must carefully consider the selection of warm-up protocols, taking into account individual differences in physiology, training background, and performance goals. However, it's essential to acknowledge the study's limitations. The relatively small sample size and the use of a 25-meter pool may restrict the generalizability of the findings. Additionally, while the study focused specifically on male swimmers in the 100-meter front crawl.

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