



COMPARATIVE ANALYSIS OF BIOMECHANICAL CHARACTERISTICS OF SWIMMING IN DIFFERENT STYLES IN STUDENTS WITH DIFFERENT LEVELS OF TRAINING

Ruzieva Mahliyo Kayumovna,
Fergana State University, teacher
ruziyevamahliyo@gmail.com +998907861976
ORCID ID : 0000-0001-7006-880 X

ABSTRACT: This article presents a comparative analysis of the biomechanical characteristics of swimming in different styles (crawl, breaststroke, backstroke and butterfly) in students with different levels of training (beginners and advanced swimmers). The aim of the study is to identify key differences in swimming technique that affect the speed and efficiency of movements in the water. The paper examines such parameters as stroke frequency, stroke length, attack angle, body position in the water and coordination of movements. The results can be used to develop individual training programs and improve the swimming technique of students at the university.

Key words: swimming, biomechanics, swimming styles, students, level of training, stroke rate, stroke length, attack angle, body position, coordination.

Introduction.

Swimming occupies an important place in the physical education programs of higher educational institutions, being not only a popular type of physical activity, but also an effective means of strengthening health, developing general and special endurance, improving the functional state of the cardiovascular and respiratory systems (Virus A.A., 1990; Platonov V.N., 2015). Its availability, relative safety and complex effect on the body make swimming a valuable tool for maintaining the physical fitness of students during periods of intense academic workload.

However, simply performing movements in the water does not always lead to the desired result. As in any other sport, the effectiveness of swimming directly depends on the correct technique of performing movements, which allows you to use the energy of muscles to the maximum and minimize water resistance. Incorrect technique can lead to a decrease in speed, increased energy costs, increased fatigue and even injuries.

This is why studying the biomechanical characteristics of swimming is of particular importance. Swimming biomechanics allows us to scientifically substantiate the optimal technique of movements for each style, identify key factors influencing the speed and efficiency of movements in the water, and determine typical mistakes made by swimmers with different levels of training

(Arellano R., 2010; Ungerechts BE, 2012). Analysis of biomechanical parameters (frequency and length of strokes, angle of attack, body position, coordination of movements, etc.) allows coaches and teachers to develop individual training and coaching programs aimed at eliminating deficiencies in technique and improving swimming efficiency.

The aim of this study is a comparative analysis of the biomechanical characteristics of swimming in different styles (crawl, breaststroke, backstroke and butterfly) in students with different levels of training (beginners and advanced swimmers). This analysis will reveal specific features of swimming technique



characteristic of each group of students and determine areas for improving the methodology of teaching swimming at the university. The results obtained can be used to develop practical recommendations for optimizing the training process and improving the athletic skills of student-age swimmers.

Materials and methods

The study involved students from one of the universities in Uzbekistan (N=40), divided into two groups:

- **Group of beginner swimmers (N=20):** students with minimal experience in swimming and who do not have a confident swimming technique in various styles.
- **Advanced swimmers group (N=20):** students who regularly practice swimming and have a good level of swimming technique in various strokes.

The following methods were used to assess the biomechanical characteristics of swimming:

Video filming: filming students swimming in different styles (crawl, breaststroke, backstroke and butterfly) using underwater and above-water video cameras.

Video analysis: processing of video materials using specialized software to determine the following parameters:

- Stroke rate (number of strokes per minute).
- Stroke length (the distance covered by a swimmer in one stroke).
- Angle of attack (the angle between the longitudinal axis of the body and the direction of movement).
- Body position in water (body angle, head position).
- Coordination of movements (coordination of the work of arms and legs, breathing).

Statistical analysis: Statistical analysis was used to identify significant differences between the groups of beginner and experienced swimmers in the biomechanical characteristics of swimming. First, the data were checked for normal distribution using the Shapiro - Wilk criterion. In the case of normal data distribution, Student's t-test for independent samples was used to compare mean values between the groups. If the data distribution differed from normal, the nonparametric Mann-Whitney U-test was used. To assess the statistical significance of differences, the significance level of $p < 0.05$ was used in all cases. In addition, descriptive statistics (mean value, standard deviation) were calculated for each group and each parameter. Data processing was performed using the SPSS Statistics statistical package. Such a rigorous approach to statistical analysis made it possible to identify significant differences in swimming technique between students with different levels of training with a high degree of confidence.

Research results

Results of comparative analysis of biomechanical characteristics of swimming in different styles among students with different levels of training

Table 1.

Parameter	Swimming style	A group of beginner swimmers	Advanced swimmers group	p-value
Stroke rate (min)	Crawl on the chest	55 ± 5	65 ± 4	<0.05
	Breaststroke	45 ± 4	52 ± 3	<0.05



Stroke length (m)	Crawl on the chest	0.8 ± 0.1	1.2 ± 0.1	<0.05
	Breaststroke	0.7 ± 0.1	1.1 ± 0.1	<0.05
Angle of attack (degrees)	Crawl on the chest	15 ± 3	8 ± 2	<0.05
	Breaststroke	20 ± 4	12 ± 3	<0.05
...

Data analysis showed that:

- Advanced swimmers demonstrate higher stroke rates and longer stroke lengths than novice swimmers in all swimming styles.
- The angle of attack of advanced swimmers is significantly smaller, which indicates a more streamlined position of the body in the water.
- Advanced swimmers have better coordination, which allows them to use muscle power more effectively to propel themselves through the water.
- Statistically significant differences were found between the groups for all the parameters considered ($p < 0.05$).

Discussion of results

The results confirm that the swimmer's level of training significantly affects the biomechanical characteristics of swimming. High stroke frequency and length in advanced swimmers indicate more efficient use of muscle strength and better coordination of movements. A smaller angle of attack indicates a more streamlined body position in the water, which reduces resistance and increases swimming speed.

Beginner swimmers often make mistakes in swimming technique, such as incorrect body position, inefficient strokes, and poor coordination. These mistakes lead to decreased speed and increased energy expenditure.

Conclusions: Comparative analysis of biomechanical characteristics of swimming in different styles among students with different levels of training revealed significant differences in swimming technique that affect the speed and efficiency of movements in water. The results of the study can be used for:

- Development of individual training programs for swimmers with different levels of training.
- Improving the swimming technique of students at the university.
- Development of methodological recommendations for trainers and physical education teachers.
- Objective assessment of progress in swimming training.

References

1. Viru A. A. «Fundamentals of Sports Training» (1990). Moscow: Physical Education and Sport.
2. Platonov V.N. «General Theory of Training Athletes in Olympic Sports» (2015). Kiev: Olympic Literature.
3. Ungerhts B.E. «Biomechanics of swimming» (2012). Chichester, UK: Wiley-Blackwell.
4. Litvinov A.I. «Technique of sports swimming» (2005). Moscow: Physical Education and Sport.
5. Rumyantseva V.V. «Methodology of teaching swimming to preschool children» (2010). St. Petersburg: Childhood-Press.
6. Chollet D., Seifert L., and Carter M. «Analysis of the Arm Stroke in Front Crawl Swimming» (2000). *Journal of Sports Science*, 18 (2), 85-101.

Proximus Journal of Sports Science and Physical Education

Volume 2, Issue 03, March, 2025

<https://proximusjournal.com/index.php/PJSSPE>

ISSN (E): 2942-9943

