INFLUENCE OF BASIC AND SPECIFIC MOTOR ABILITIES ON START AND TURNS IN 8–12-YEAR-OLD SWIMMERS

Bogomil Angelov & Stanislava Sarandeva
National Sports Academy "Vassil Levski", Sofia, Bulgaria

ABSTRACT
Introduction: Effective performance of starts and turns is crucial for competitive success in swimming, particularly over short distances. These elements are strongly determined by lower limb strength. Modern training approaches emphasize the relationship between physical capacities developed on dry land and technical skills in the aquatic environment. Investigating these relationships is essential for optimizing the training process of young swimmers. Purpose: The aim of this study is to analyze the relationship between lower limb strength (standing long jump) and specific indicators of swimming performance (15-m maximum freestyle swim, 25-m maximum kicking with a board, streamline distance, and turn performance) in young male and female swimmers aged 8–12 years. Methods: A total of 20 swimmers (12 boys and 8 girls) aged 10.9 ± 1.3 years participated in the study. Anthropometric measurements (height and body weight) and functional tests were conducted, including a standing long jump, a 15-meter maximum freestyle swim, a 25-meter maximum kicking with a board, a streamline distance after start and push-off, and times for covering 5 and 10 meters after turning. Statistical analysis included variation analysis and Spearman's correlation coefficients. Results: Significant correlations were observed between dry-land test results and aquatic performance parameters. The standing long jump showed a strong negative correlation with the 15-meter freestyle time (ρ = -.812). The streamline distance after start also demonstrated a significant negative correlation with the 15-meter time (ρ = -.641). Additional strong correlations were found between the standing long jump and turn performance (ρ = –.642 for 5+5 m and ρ = -.637 for 5+10 m), as well as between the 15-m freestyle and both turn performance indicators (ρ = .739 and ρ = .785, respectively; p < .05). Conclusions: Motor abilities developed on dry land, particularly those of the lower limbs, along with streamline efficiency, play a crucial role in the performance of starts, turns, and short-distance swimming achievements in young athletes. Emphasizing the development of these capacities should be a priority in the training process.

ORCID
Bogomil Angelov
https://orcid.org/0000-0002-3510-1915
Stanislava Sarandeva
https://orcid.org/0009-0009-1763-3676
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INTRODUCTION

In modern competitive swimming, we observe an increasing density in performance results. Finalists in major championships are often separated by mere hundredths of a second (Andonov, Angelov, 2024). Even qualification for the finals can be determined by marginal time differences. With the advancement of new technologies and video analysis tools, every technical detail has gained tremendous importance for the outcome (Cossor & Mason, 2001; Mason, Alcock, & Fowlie, 2007). Since the early 21st century, these innovations have notably influenced the quality of starts and turns. It is well known that the highest velocity in swimming occurs during the start, offering a critical opportunity to gain an early advantage over opponents.

Swimming performance, particularly in sprint events, is critically influenced by the execution of starts and turns, which can account for a substantial portion of race time—up to 26% for the start phase (Vantorre, Chollet, Seifert, 2014). An analysis of Olympic results between 1972 and 2004 revealed that a 0.1-second improvement—a difference achievable with a better start—would have changed the medal distribution in 65 sprint events. A similar trend was observed during the 2008 Beijing Olympics, where the difference between the top two female finishers in the 50m and 100m events was less than 1%, a difference heavily influenced by the start. The critical importance of the start has prompted a growing body of research focused on the biomechanical parameters and optimization of the start technique.

Among young swimmers, the role of the start is

even more pronounced, as performance is influenced not only by technical execution but also by the development of general motor abilities such as lower limb strength.

Turns also play a vital role in performance. The push-off from the wall generates the second-fastest phase of the race. When the underwater phase is included, the combined contribution of starts and turns to total race distance can reach between 30% and 56%, depending on the race distance and swimmer level (Arellano, Moreno, Martinez, Oña, 1996; González-Ravé et al., 2025; Lyttle, Benjanuvatra, 2005; Vilas-Boas et al., 2003). Consequently, even minor improvements in start and turn technique can significantly influence final outcomes (Hay, 1992).

The streamline position is a key element at the beginning of the competitive phase, following a start or turn, as it minimizes drag and allows swimmers to cover the maximum distance before initiating kicks or strokes (McIntyre & Langrana, 2003). An improper streamline or premature transition to underwater movements increases drag and decreases efficiency.

Numerous studies emphasize the importance of developing both basic and specific motor abilities in young swimmers. According to Jorgić et al. (2010), both categories of motor skills—basic (e.g., strength, coordination, flexibility) and specific (e.g., stroke rate, stroke length, start time)—have a statistically significant impact on 100-meter freestyle performance in swimmers aged 9 to 12. Variables such as the standing long jump, medicine ball throw from a prone position, and sit-and-reach flexibility test have proven especially predictive of sprint performance.

At the same time, earlier studies have mainly focused on broad measures of motor abilities and overall swimming performance, without directly examining how explosive lower limb strength contributes to the efficiency of starts and turns. This gap highlights the need for further research in younger age groups, where the development of motor abilities is most dynamic.

Despite the increasing amount of research, a gap remains concerning the role of lower limb strength in relation to start and turn efficiency among young swimmers. In this context, the present study examines the relationship between a general motor ability (standing long jump) and specific performance indicators (e.g., 15-meter freestyle time, 25-meter kick test, and turn performance) in swimmers aged 8 to 12 years.

Aim and Objectives

The aim of this study is to analyze the relationship between lower limb strength, assessed through the standing long jump, and specific indicators of swimming performance (15-m maximum freestyle effort, 25-m maximum kicking with a board, streamline distance, and turn performance) in young athletes aged 8–12 years.

METHODOLOGY

The present study involved a total of 20 swimmers (12 male and 8 female) aged between 8 and 12 years (mean age: 10.9 ± 1.3 years). The age of each participant was calculated with precision to the nearest month and was recorded in decimal format. All participants were actively engaged in competitive swimming and followed a regular training schedule. Anthropometric measurements included body height (in centimeters) and body weight (in kilograms), obtained according to standard measurement procedures, with participants barefoot and wearing light training attire.

Study design

This was a cross-sectional study carried out during the preparatory phase of the training season. All participants completed the same battery of tests within a single testing session. The session began with a standardized dry-land warm-up (5 minutes of light running and dynamic stretching), followed immediately by the standing long jump test to assess lower-limb explosive strength. After this, swimmers performed an in-water warm-up (10 minutes of easy swimming combined with dynamic drills) to prepare for the aquatic assessments. The sequence of in-water tests was fixed and non-randomized: 15-meter maximum freestyle swim from a dive start, 25-meter maximum kicking with a board, streamline distance after dive, streamline distance after wall push-off, and finally the turn performance tests (5 + 5-meter and 5 + 10-meter). A rest interval of 3–5 minutes was provided between tests to minimize fatigue. Because the order of tests was not randomized, this is considered a limitation of the study.

To assess both general and swimming-specific motor abilities, a battery of tests was administered. The test protocol consisted of the following: standing long jump (used to evaluate lower-limb explosive strength), a 15-meter maximum freestyle swim from a dive start (measuring initial sprint speed), and a 25-meter freestyle kick test with push-off from the wall using a kickboard. Additionally,

streamline efficiency was assessed through two trials—one after a dive and another after a wall push-off—by measuring the distance traveled in a streamlined body position without initiating kicks or strokes. Turn performance was evaluated through two tests: the 5 + 5-meter test (time to swim 5 meters into the wall, perform a turn, and swim 5 meters out) and the 5 + 10-meter test (same procedure, but with 10 meters swam after the turn). The selection of these tests was based on their established reliability and validity for evaluating explosive strength and short-distance swimming performance in youth athletes, as supported by previous research in swimming biomechanics. The standing long jump is widely accepted as a reliable measure of lower-limb explosive strength, while the short-distance sprint, kick, streamline, and turn tests directly capture performance components critical to competitive swimming, including those that determine the effectiveness of the start and turn phases.

All aquatic tests were conducted in a 25-meter indoor swimming pool under controlled conditions. Time and distance measurements were collected by experienced evaluators using digital stopwatches and visual reference points.

Data analysis was performed using both descriptive and inferential statistics. Descriptive (variational) statistics included the calculation of means, standard deviations, and minimum and maximum values for all measured variables. To examine the relationships between lower limb strength and specific swimming performance indicators, Spearman's rank correlation analysis was applied.

Due to the small sample size (under 30) and the expected non-normal distribution of the performance variables, Spearman's rank correlation coefficient was used to analyze the relationships between the results of general motor ability tests and specific swimming performance indicators. All statistical procedures were performed using SPSS Statistics software (IBM Corp., Armonk, NY, USA).

Ethical considerations

The study was conducted in accordance with the ethical principles for research involving human participants and with the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participants prior to the study. The consent form clearly explained the purpose, procedures, and voluntary nature of participation, as well as the right to withdraw at any time without consequences.

RESULTS

The descriptive statistics for all variables are presented in Table 1. The participants had a mean age of 10.91 ± 1.33 years, with body height ranging from 134.6 cm to 167.0 cm, and body weight ranging from 28.7 kg to 51.5 kg. In the dry-land test, the standing long jump showed considerable variability (M = 162.81 cm, SD = 20.61 cm), reflecting interindividual differences in explosive leg strength.

Performance in swimming-specific tasks also varied. The mean time for the 15-meter freestyle sprint was 9.76 ± 0.98 seconds, and for the 25-meter kicking test, 25.71 ± 4.02 seconds. Streamline distances after start and push-off were 10.36 ± 1.19 m and 8.69 ± 1.07 m, respectively, indicating variation in underwater glide efficiency. Times for the turn tests were 7.66 ± 0.79 s (5+5 m) and 11.84 ± 1.09 s (5+10 m).

Table 1. *Descriptive Statistics for All Study Variables*

Variable	*Mean*	*SD*	Minimum	Maximum
Age	10.91	1.33	8.2	13.7
Height	148.69	8.59	134.6	167.0
Weight	36.45	6.33	28.7	51.5
Long jump	162.81	20.61	126.0	197.5
15 max free	9.76	0.98	8.28	11.64
25 kick max	25.71	4.02	20.23	39.1
Streamline Start	10.36	1.19	8.5	13.0
Streamline Push-off	8.69	1.07	7.0	10.5
Turn 5+5	7.66	0.79	6.35	9.26
Turn 5+10	11.84	1.09	10.01	13.75

Spearman's correlation analysis (Table 2) revealed several significant relationships. The standing long jump showed a strong negative correlation with 15 m max swim time (ρ = –.812, p < .001), indi-

cating that greater leg power was associated with faster sprint times. Similarly, negative correlations were found between the long jump and turn performance times, for both the 5+5 (ρ = –.642) and 5+10 (ρ = –.637) m tests.

Table 2. *Spearman Correlation Coefficients Between Motor and Swimming Performance Variables*

	Long jump	15 max free	25 kick max	Streamline Start	Streamline Push-off	Turn 5+5	Turn 5+10
Long jump	1.000	-.812***	-.514*	.384	.182	-.642**	-.637**
15 max free	-.812***	1.000	.786***	-.641**	-.329	.739**	.785***
25 kick max	-.514*	.786***	1.000	-.588**	-.377	.548*	.566**
Streamline Start	.384	-.641**	-.588**	1.000	.675**	-.675**	-.658**
Streamline Push-off	.182	-.329	-.377	.675**	1.000	-.514*	-.489*
Turn 5+5	-.642**	.739***	.548*	-.675**	-.514*	1.000	.967***
Turn 5+10	-.637**	.785***	.566**	-.658**	-.489*	.967***	1.000

*Note. Spearman's rank correlation coefficient (ρ). *p < .05, **p < .01, **p < .001.*

The streamline distance after the start also correlated negatively with 15 m time (ρ = –.641, p = .002), suggesting that swimmers who maintained a longer streamline had better sprint performance. Notably, the 15 m max swim time correlated positively with 25 m kick time (ρ = .786, p < .001), and with turn times (ρ = .739, p < .001 for 5+5 m, ρ = .785, p < .001 for 5+10 m), reflecting consistent performance across short-distance efforts. A moderate-to-strong relationship was observed between streamline distances after dive and push-off (ρ = 0.675, p = .001), confirming technical consistency in the underwater phases.

DISCUSSION

The results of this study highlighted the significant influence of lower-limb explosive strength on sprint performance and technical elements such as starts and turns in young swimmers. The strong correlation between the standing long jump and 15m swim time emphasized the role of lower-body explosive power, which contributed directly to more effective take-offs and wall push-offs.

Furthermore, the observed correlations between streamline distances and sprint times validated the importance of hydrodynamic positioning in maximizing underwater efficiency. Swimmers who achieved longer glide phases after the start or turn tended to record faster times, underlining the need to train not only for propulsion but also for optimal body alignment and tension.

The strong positive correlations between the 15 m time and both the 25 m kick and turn tests supported the idea that these elements are interdependent—athletes who performed well in one tended to excel in the others. This further strengthened the argument for integrated training approaches that address power development, technical precision, and streamline control simultaneously.

Although most variables showed moderate to strong correlations, it is important to note the individual variability present, as reflected in the wide ranges of performance measures. This reinforces the necessity for individualized coaching strategies that consider each athlete's strengths and weaknesses.

The contribution of the present study lies in providing reference values for short-distance swimming performance and associated dry-land and in-water tests in boys and girls aged 8–12 years. These values may serve as practical benchmarks for coaches when evaluating strength and swimming efficiency in youth. Moreover, the correlation patterns identified in this study—particularly the strong links between explosive strength, start/turn efficiency, and sprint outcomes—add to the existing literature by documenting relationships that have not been thoroughly examined in this specific age group.

Overall, the findings support the hypothesis that dry-land motor abilities, particularly explosive strength, are closely linked with swimming performance in young athletes, especially in short-distance races where start and turn quality have a disproportionate impact.

CONCLUSION

Motor abilities developed on dry land—particularly those of the lower limbs—together with streamline efficiency, play a crucial role in the effectiveness of starts, turns, and short-distance swimming performance in young athletes. The findings of this study highlight the strong link between explosive

strength and specific aspects of swimming performance, suggesting that targeted development of these capacities should remain a central focus in the training process. Integrating dry-land conditioning with technical refinement can significantly enhance early competitive outcomes and long-term athlete development.

Additionally, by presenting age-specific values and new evidence of strong correlations between lower-limb strength and swimming performance indicators, this study contributes practical knowledge for youth training programs and expands the empirical base on the role of strength in start and turn performance. Nevertheless, the current sample size limits the generalization of the findings; further research with larger cohorts is required to establish evaluation standards and more precise reference values for this age group.

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Corresponding author:
Bogomil Angelov, Ph.D
Faculty of Public Health, Health Care and Tourism,
National Sports Academy "Vassil Levski",
21, Acad. Stefan Mladenov str.,
Studentski grad, 1700 Sofia, Bulgaria
E-mail: bogomil.angelov@nsa.bg

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