

Application of selected speed development exercises for the national swimming team at Danang National Sports Training Center

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Abstract:

This study examined the selection and application of scientifically grounded speed development exercises to enhance short-distance swimming performance among elite athletes at Danang National Sports Training Center, Vietnam. Given that sprint performance is a decisive factor in competitive swimming, the study aimed to address existing performance limitations through a structured and context-appropriate training program. Twenty national-level swimmers (10 males, 10 females) were randomly assigned to either an experimental or control group. The experimental group participated in a six-month intervention that incorporated 29 exercises selected based on expert opinions ($\geq 80\%$ approval), categorized into aerobic ($n=12$), anaerobic ($n=9$), and mixed ($n=8$) types. The control group continued with the standard of the national training program. Performance was assessed before and after the intervention using five tests: 25 m and 50 m freestyle, 200 m main stroke, 10×50 m (with 45-second rest), and 6×200 m (total time recorded). Results showed statistically significant improvements ($p < 0.05$) across all tests in the experimental group compared to the control group, validating the efficacy of the selected exercises. The study also identified four core principles for exercise selection: scientific justification, alignment with athlete capabilities, compatibility with existing facilities, and inclusion of techniques to maintain speed and initiate acceleration at critical points during races. The findings contribute practical insights for coaches and training institutions operating with insufficient resources, demonstrating that scientifically informed training models can yield substantial performance gains without reliance on advanced technology. This study also presents a replicable intervention framework adaptable to other national teams or training centers with similar limitations.

Keywords: Speed development, sprint performance, training intervention, competitive swimming, resource-constrained environments, Danang National Sports Training Center, elite athletes.

Introduction

Achieving elite performance in competitive swimming, especially in short-distance events, requires the integration of anaerobic power, biomechanical precision, and psychological readiness. While Vietnam has made notable strides in aquatic sports at regional competitions, significant gaps remain compared to international standards, particularly in sprint events. The underperformance of Vietnamese swimmers in 50m and 100m events at recent SEA Games highlights a pressing need for scientifically informed interventions that go beyond traditional training frameworks. Despite focused investments and centralized training at key national sports centers, limitations persist—especially in anaerobic capacity and speed development. In this context, Danang National Sports Training Center plays a critical role, serving as a base for top-tier swimmers such as Hoang Quy Phuoc and Le Thi My Thao. However, assessments of training programs have shown that athletes still struggle with optimizing race-speed performance due to inadequate anaerobic conditioning.

Global literature emphasizes the importance of speed-specific training in improving sprint outcomes (Aspenes & Karlsen, 2012; JPES, 2020). Yet, in Vietnam, there is a lack of tailored, evidence-based training models that systematically address the physiological demands of short-distance swimming. This study builds on prior findings and aims to fill this gap by selecting and applying a scientifically validated set of speed development exercises suited to the national context.

Problem Statements In competitive swimming, particularly at the sprint distance level, performance is highly dependent on explosive power, speed endurance, and the effective use of anaerobic energy systems. Despite focused investment in training infrastructure and coaching staff, Vietnamese national swimmers have shown limited success in short-distance events at regional competitions. This performance stagnation is especially apparent among athletes at Danang National Sports Training Center, where objective testing has indicated deficiencies in speed capacity and anaerobic conditioning.

A review of the existing training programs revealed a lack of systematically applied speed development exercises grounded in sports science. Most training programs emphasize general endurance and technical practice but insufficiently address the neuromuscular and energy system adaptations necessary for sprint

performance. Moreover, existing literature in Vietnam has not fully addressed the design, validation, and implementation of specific exercise protocols for short-distance swimming in a structured and evidence-based manner. Given these shortcomings, there is an urgent need for a scientifically guided intervention that focuses on selecting and applying targeted speed development exercises tailored to national athletes' physiological and contextual needs. Without such interventions, the potential of elite swimmers to compete at higher international levels remains limited.

Approaches This study adopted a mixed-method research approach that combined qualitative and quantitative techniques to ensure the accuracy and relevance of the intervention. Initially, a review of national and international literature on speed training in swimming was conducted to identify theoretical foundations and best practices. This was followed by expert interviews with 20 experienced coaches, researchers, and sport scientists to determine principles for exercise selection and contextual adaptation. Based on the consensus criteria ($\geq 80\%$ agreement), 29 speed development exercises were selected and classified into aerobic, anaerobic, and mixed energy system categories. These exercises were tailored to match the athletes' performance levels and the facilities at Danang National Sports Training Center. The experimental design involved a six-month intervention with 20 national-level swimmers, divided equally into control and experimental groups randomly. The experimental group integrated the selected exercises into their training, while the control group maintained the standard of the national program. Pre- and post-tests using five performance indicators (25m, 50m, 200m, 10×50 m, 6×200 m) were conducted in a 50m standardized pool. Statistical analysis using paired and independent t-tests determined the significance of performance changes, validating the efficacy of the applied approach.

Methods

Participants

Twenty swimmers (10 males, 10 females) aged 18–23 from Danang National Sports Training Center participated in the research. Participants were randomly assigned to experimental and control groups ($n = 10$ each), ensuring gender balance.

Training Intervention

The intervention lasted six months and consisted of 29 exercises selected through expert consensus (approval $\geq 80\%$). Exercises were classified into aerobic ($n = 12$), speed ($n = 9$), and mixed aerobic-anaerobic ($n = 8$) categories. The experimental group trained 10 sessions per week, integrating the selected exercises, while the control group maintained the standard of the national training program.

Performance Testing

Athletes completed five swimming performance tests both before and after the intervention: 25 m freestyle, 50 m freestyle, 200 m main stroke, 10×50 m (with 45 s rest), and 6×200 m (total time recorded). Tests were conducted in a standardized 50 m pool.

Statistical Analysis

Paired and independent t-tests were used to analyze intra-group and inter-group differences. Statistical significance was set at $p < 0.05$.

Results of research

Current practices of speed capacity among athletes of the national swimming team at Danang National Sports Training Center

The study was conducted to compare the swimming performance across five tests using the same subjects, who are national-level athletes from two teams: Can Tho (6 athletes) and Ho Chi Minh City (5 athletes). The results are presented in Table 1.

Table 1. Comparison of Speed Capacity Between National Swimming Team Athletes at Danang National Sports Training Center and National Team Athletes from Can Tho and Ho Chi Minh City

No	Test	National Swimming Team Athletes at the Da Nang National Sports Training Center	National Swimming Team Athletes at the Can Tho National Sports Training Center	National Swimming Team Athletes at the Ho Chi Minh City National Sports Training Center	t ₁₋₂	t ₁₋₃	P
		Male					
		Mean ± SD	Mean ± SD	Mean ± SD			
1	25 m freestyle (s)	11.28 ± 1.23	11.12 ± 1.10	11.28 ± 1.13	2.73	0.82	0.05
2	50 m freestyle (s)	25.66 ± 2.17	25.52 ± 2.16	25.64 ± 2.09	2.87	1.16	0.05
3	200 m main swimming event (s)	120.75 ± 4.87	120.77 ± 5.11	120.61 ± 4.86	3.02	2.76	0.05
4	10 × 50 m freestyle swimming (45 s walk and rest) (s)	320.03 ± 11.04	317.91 ± 11.42	320.07 ± 11.18	2.27	2.88	0.05
5	6 × 200 m swimming (walk and rest, final record counted) (s)	125 ± 4.74	124.92 ± 4.23	124.93 ± 4.61	2.85	0.87	0.05
No	Test	Female			t ₁₋₂	t ₁₋₃	P
		Mean ± SD					
		Mean ± SD	Mean ± SD	Mean ± SD			
1	25 m freestyle (s)	14.31 ± 1.24	14.14 ± 1.1	14.29 ± 1.11	2.64	0.75	0.05

2	50 m freestyle (s)	29.39 ± 2.08	29.61 ± 2.31	29.38 ± 2.14	2.91	1.21	0.05
3	200 m main swimming event (s)	140.55 ± 4.51	140.54 ± 4.91	140.55 ± 4.51	2.93	2.81	0.05
4	10 × 50 m freestyle swimming (45 s walk and rest) (s)	360.05 ± 11.55	358.91 ± 11.19	360.04 ± 11.56	2.26	2.92	0.05
5	6 × 200 m swimming (walk and rest, final record counted) (s)	145.06 ± 4.78	145.07 ± 4.8	145.1 ± 4.76	2.86	0.88	0.05

Based on the results in Table 1, the following observations can be made:

In the 25 m Freestyle Test (s): The national swimming team athletes at Danang National Sports Training Center performed worse than those from the Can Tho team. Compared to the Ho Chi Minh City team, no significant difference was observed ($t_{\text{calculated}} < t_{\text{table}} = 0.82$).

In the 50m Freestyle Test (s): The athletes from Danang performed significantly worse than those from Can Tho ($p < 0.05$). However, there was no significant difference compared to the Ho Chi Minh City team ($t_{\text{calculated}} < t_{\text{table}} = 1.16$).

In the 200m Main Stroke Test (s): The Danang athletes performed worse than the Can Tho team, but better than the Ho Chi Minh City team ($p < 0.05$).

In the 10 × 50m Freestyle Test (with 45s rest between repetitions): The Danang team performed worse than the Ho Chi Minh City team but better than the Can Tho team ($p < 0.05$).

In the 6 × 200m Test (final repetition result recorded, with rest intervals): The athletes from Danang were outperformed by the Ho Chi Minh City team but showed better results than the Can Tho team ($p < 0.05$).

Selecting speed development exercises for national swimming athletes at Danang National Sports Training Center

To select and apply speed development exercises for athletes of the national swimming team at Danang National Sports Training Center, research was conducted on the following aspects: identifying the principles of selecting speed development exercises, comprehensively developing basic physical qualities for professional physical improvement, gradually increasing the intensity of professional physical training to support technical performance and lay the foundation for enhancing professional achievements, and focusing on the development of strength and endurance.

Based on the goals and the current practices of the athletes, interviews were conducted with 20 experienced experts, coaches, lecturers, and referees to improve objectivity and reliability in determining the principles of selecting effective exercises. The results are shown in Table 2.

Table 2. Interview Results for Identifying Basic Principles in Selecting Speed Development Exercises for Athletes of the National Swimming Team at Danang National Sports Training Center (n=20)

No	Principles	Result			
		Approval		Disapproval	
		n	Percentage %	n	Percentage %
1	Exercises have to be comprehensive and science-proved	19	95	1	5
2	Exercises focus on improving achievements	15	75	5	25
3	Exercises meet fundamental training principles and athletes' conditions	20	100	0	0
4	Exercises maintain the stability of speed and perform acceleration at the decisive moment	19	95	1	5
5	Diverse and interesting exercises	15	75	5	25
6	Exercises need to be suitable with current training conditions and existing facilities	20	100	0	0

According to the data, four principles were approved at a level of 90% or higher. Thus, the researchers identified the following basic principles:

Principle 1: Selected exercises must be comprehensive and scientifically proven, with clearly defined details for each training phase, and must aim to improve performance.

Principle 2: Exercises must follow fundamental training principles and be appropriate for the athletes' psychological traits and qualifications.

Principle 3: Exercises should help maintain swimming speed stability throughout the race and include the ability to accelerate effectively at decisive moments without negatively impacting overall performance.

Principle 4: Exercises must suit the current training conditions and available facilities.

These principles serve as a scientific basis for confirming the appropriateness of the selected speed development exercises.

Regarding expert opinions on suitable types of exercises, the survey results show:

- Speed exercises: 15%
- Aerobic exercises: 25%
- Aerobic-anaerobic exercises: 60%

The distribution of exercise types used in different training periods is illustrated in Figure 1.

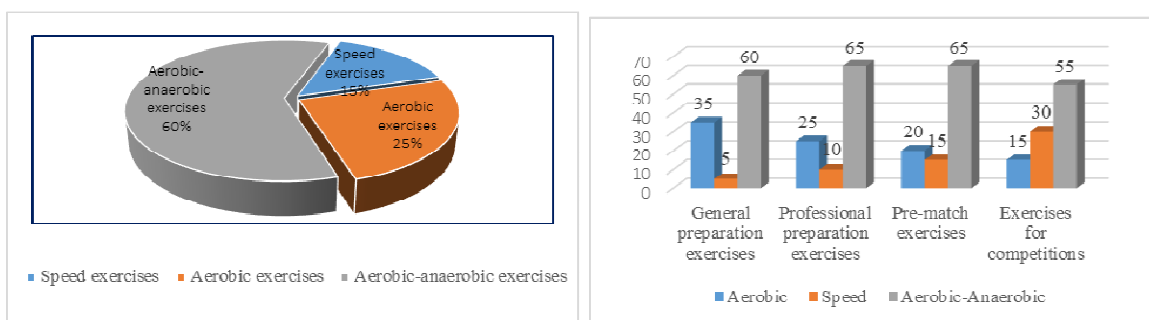


Figure 1: The utilization of different exercises in each training period

Furthermore, to establish a foundation for the accurate and effective selection of exercises, and to ensure objectivity and scientific validity, the interview results are shown in Table 3.

Table 3. Selecting exercises of speed improvement for the national swimming team at Danang National Sports Training Center (n=20)

No	Exercises	Approval (n)	%
Aerobic exercise group			
1	1500 m freestyle	16	80
2	Swimming 20 × 100 m, rest interval (r) = 10 s, 120–150 pulses/min	19	95
3	Swimming 6–10 × 400 m, r = 10–15 s	18	90
4	Swimming 1500 m (changing to average speed every 100 m)	17	85
5	Swimming 2 × 100 m per leg, r = 2 min	16	80
6	Swimming 2 × 100 m per arm, r = 2 min	15	75
7	Swimming 12 × 50 m arm (3 × 50 m per arm), r = 1 min	17	85
8	Swimming 12 × 50 m leg (3 × 50 m per leg), r = 1 min	15	75
9	Swimming 10 × 100 m medley, r = 4 min	19	95
10	Swimming 4 × 800 m, r = 30 s, 120–150 pulses/min	18	90
11	Running 4–6 km, 120–170 pulses/min	15	75
12	Cycling on a machine for 30–45 min at average intensity	17	85
13	Swimming 8–10 × 200 m, r = 40 s, 160–180 pulses/min	15	75
14	Swimming 3000 m, 120–150 pulses/min	19	95
15	Swimming 6 × 400 m, r = 30–40 s, 150–170 pulses/min	20	100
16	Swimming 400–600 m, speed margin (high acceleration at final 7.5 m, slower at turn-around swimming 7.5 m + 35 m), 4 styles	15	75
17	Swimming 2000 m, 120–150 pulses/min	19	95
Speed exercises group			
1	Swimming 5–10 × 15 m (each style), r = 1 min 15 s to 1 min 30 s	20	100
2	Swimming 6–12 × 25 m (each style), r = 1 min 30 s to 1 min 45 s	15	75
3	Swimming 4–6 × 20 m (each style), r = 1 min 15 s to 1 min 30 s	17	85
4	Swimming 6–8 × 50 m (each style), r = 1 min 45 s to 2 min	20	100
5	Swimming 4–8 × (2 × 25 m), r = 5 s, total rest (r total) = 2–5 min	20	100
6	Swimming 4–6 × (4 × 25 m), r = 10 s, r total = 2–5 min	15	75
7	Spinning (7.5 m swim and 7.5 m kick-off), 4–6 times per style, r = 2 min	19	95
8	Swimming 2–4 × 15 m, hand touching the wall (each style), r = 1 min 30 s	17	85
9	Swimming 2–4 × 15 m, foot kicking the wall (each style), r = 1 min 30 s	19	95
10	Medley swimming 4–6 × 15 m, touching the wall, r = 1 min 30 s	20	100
11	Arm spinning in prone position on the ground, 4 × 10 s, r = 1 min 30 s	17	85
12	Arm spinning in supine position on the ground, 4 × 10 s, r = 1 min 30 s	15	75
Aerobic-anaerobic exercises group			
1	Swimming 4 × 200 m, r = 30 s	18	90
2	Starting 10–12 × 50 m arm (each style), r = 1 min 30 s	17	85
3	Starting 10–12 × 50 m leg (each style), r = 1 min 30 s	14	70
4	Starting 6 × 100 m (each style), r = 8 min	15	75
5	Starting 4 × 150 m, r = 10 min	19	95
6	Swimming 16–30 × 50 m, r = 20–25 s	17	85
7	Swimming 600–800 m, 150–170 pulses/min	16	80
8	Swimming 2 × (15 × 50 m), r = 1 min 40 s, 60–180 pulses/min	17	85
9	Swimming 4–6 × 200 m, starting every 3 min, swim + rest = 6 min	15	75
10	Swimming 12–16 × 50 m (each style), r = 10–15 s	18	90
11	Swimming 4 × 200 m (each style), alternating 50 m at maximum speed and 50 m relaxed	19	95
12	Swimming 10 × 50 m arm (6 × 50 m per style), r = 1 min	15	75

According to Table 3, there are 29 exercises with a high percentage of approval, accounting for 80% or more, in which:

The aerobic group consists of 12 exercises designed to enhance endurance:

1. 1500 m freestyle
2. Swimming 20 × 100 m, rest interval (r) = 10 s, 120–150 pulses/min
3. Swimming 6–10 × 400 m, r = 10–15 s
4. Swimming 1500 m (changing to average speed every 100 m)
5. Swimming 2 × 100 m per leg, r = 2 min
6. Swimming 12 × 50 m arm (3 × 50 m per arm), r = 1 min

Applying and Evaluating the Effectiveness of Speed Development Exercises

Conducting the Practical Experiment

The research employed a parallel comparative experimental design.

The subjects were 10 male and 10 female athletes, randomly divided into two groups:

Experimental group: 5 athletes received additional speed development training designed by the researchers, integrated with the standard training program for each gender.

Control group: 5 athletes followed only the standard of the training program without any additional exercises.

To objectively evaluate the effectiveness of the selected speed development exercises, researchers compared the performance of both male and female groups using five tests before and after the experiment. Statistical analysis was conducted using mathematical statistics. The results before the experiment are shown in Table 4.

Table 4. Comparison of Speed Between Experimental and Control Groups Before the Experiment

No	Test	Experimental group (n=5)	Control group (n=5)	t	p
		Male			
		Mean $\pm$ SD	Mean $\pm$ SD		
1	25 m freestyle (s)	11.1 $\pm$ 0.7	11.1 $\pm$ 0.7	0.111	> 0.05
2	50 m freestyle (s)	25.6 $\pm$ 1.2	25.5 $\pm$ 1.2	0.308	> 0.05
3	200 m main swimming event (s)	120.7 $\pm$ 2.3	120.8 $\pm$ 2.2	0.041	> 0.05
4	10 $\times$ 50 m freestyle swimming (45 s walk and rest) (s)	320.0 $\pm$ 3.8	317.9 $\pm$ 3.8	0.361	> 0.05
5	6 $\times$ 200 m swimming (walk and rest, final record counted) (s)	125.0 $\pm$ 1.6	125.0 $\pm$ 1.6	0.098	> 0.05
No	Test	Experimental group (n=5)	Control group (n=5)	t	p
		Female			
		Mean $\pm$ SD	Mean $\pm$ SD		
1	25 m freestyle (s)	14.4 $\pm$ 0.8	14.1 $\pm$ 0.7	1.281	> 0.05
2	50 m freestyle (s)	29.5 $\pm$ 1.3	29.7 $\pm$ 1.2	0.276	> 0.05
3	200 m main swimming event (s)	140.5 $\pm$ 2.3	140.4 $\pm$ 2.2	0.045	> 0.05
4	10 $\times$ 50 m freestyle swimming (45 s walk and rest) (s)	360.0 $\pm$ 3.7	359.1 $\pm$ 3.8	0.161	> 0.05
5	6 $\times$ 200 m swimming (walk and rest, final record counted) (s)	145.0 $\pm$ 1.5	145.1 $\pm$ 1.5	0.054	> 0.05

($t_{\text{standard}} = 2.306$)

Results in Table 4 indicate that there were no statistically significant differences ($p > 0.05$) between the experimental and control groups for both male and female athletes prior to the experiment. This confirms that the two groups were comparable at the pre-intervention stage.

The Experimental Process

After grouping, the experimental process was implemented over a six-month period, from February 2019 to July 2019.

The control group (5 athletes) continued with their regular training schedules.

The experimental group (5 athletes) trained using 51 newly selected speed development exercises.

Ten sessions of training were carried out per week over 24 weeks. After the experiment, the same performance tests were conducted. The results are shown in Table 5

Table 5. Comparison of Speed Between Experimental and Control Groups After the Experiment

No	Test	Experimental group (n=5)	Control group (n=5)	t	p
		Male			
		Mean $\pm$ SD	Mean $\pm$ SD		
1	25 m freestyle (s)	10.6 $\pm$ 0.7	11.1 $\pm$ 0.8	2.485	< 0.05
2	50 m freestyle (s)	24.1 $\pm$ 1.2	25.4 $\pm$ 1.2	2.337	< 0.05
3	200 m main swimming event (s)	115.2 $\pm$ 2.1	120.1 $\pm$ 2.2	2.575	< 0.05
4	10 $\times$ 50 m freestyle swimming (45 s walk and rest) (s)	301.7 $\pm$ 3.7	316.5 $\pm$ 3.8	2.589	< 0.05
5	6 $\times$ 200 m swimming (walk and rest, final record counted) (s)	120.3 $\pm$ 1.6	124.2 $\pm$ 1.6	3.832	< 0.05
No	Test	Experimental group (n=5)	Control group (n=5)	t	p
		Female			
		Mean $\pm$ SD	Mean $\pm$ SD		

1	25 m freestyle (s)	13.8 ± 0.7	14.0 ± 0.5	3.076	< 0.05
2	50 m freestyle (s)	28.5 ± 1.2	29.6 ± 0.8	2.759	< 0.05
3	200 m main swimming event (s)	135.1 ± 2.0	140.0 ± 2.0	2.873	< 0.05
4	10 × 50 m freestyle swimming (45 s walk and rest) (s)	346.7 ± 3.6	357.5 ± 3.1	3.243	< 0.05
5	6 × 200 m swimming (walk and rest, final record counted) (s)	140.4 ± 1.7	144.2 ± 1.6	4.668	< 0.05

($t_{\text{standard}} = 2.306$)

The results show statistically significant improvements ($p < 0.05$) in all five performance tests for the experimental group, while the control group showed little to no significant change.

Table 6. Comparing the development rate of speed of the control group before and after the experiment

No	Test	Before experiment (n=5)	After experiment (n=5)	t	p
		Male			
		Mean ± SD	Mean ± SD		
1	25 m freestyle (s)	11.1 ± 0.7	11.1 ± 0.8	0.096	> 0.05
2	50 m freestyle (s)	25.5 ± 1.2	25.4 ± 1.2	0.186	> 0.05
3	200 m main swimming event (s)	120.8 ± 2.2	120.1 ± 2.2	0.358	> 0.05
4	10 × 50 m freestyle swimming (45 s walk and rest) (s)	317.9 ± 3.8	316.5 ± 3.8	0.240	> 0.05
5	6 × 200 m swimming (walk and rest, final record counted) (s)	124.9 ± 1.6	124.2 ± 1.6	0.732	> 0.05
No	Test	Before experiment (n=5)	After experiment (n=5)	t	p
		Female			
		Mean ± SD	Mean ± SD		
1	25 m freestyle (s)	14.1 ± 0.7	14.0 ± 0.5	0.489	> 0.05
2	50 m freestyle (s)	29.7 ± 1.2	29.6 ± 0.8	0.093	> 0.05
3	200 m main swimming event (s)	140.4 ± 2.2	140.0 ± 2.0	0.239	> 0.05
4	10 × 50 m freestyle swimming (45 s walk and rest) (s)	359.1 ± 3.8	357.5 ± 3.1	0.320	> 0.05
5	6 × 200 m swimming (walk and rest, final record counted) (s)	145.1 ± 1.5	144.2 ± 1.6	0.889	> 0.05

($t_{\text{standard}} = 2.776$)

Results showed significant improvements in the experimental group ($p < 0.05$) across all tests, with no notable changes in controls ($p > 0.05$).

Table 7. Comparing the improvement in group speed before and after the experiment

No	Test	Before experiment (n=5)	After experiment (n=5)	t	p
		Male			
		Mean ± SD	Mean ± SD		
1	25m freestyle (s)	11.1 ± 0.7	10.6 ± 0.7	3.076	< 0.05
2	50m freestyle (s)	25.6 ± 1.2	24.1 ± 1.2	2.759	< 0.05
3	200m main swimming subject (s)	120.7 ± 2.3	115.2 ± 2.1	2.873	< 0.05
4	10x50m freestyle swimming (walk and rest 45') (s)	320.0 ± 3.8	301.7 ± 3.7	3.243	< 0.05
5	6x200m swimming, walk and rest, count the final record (s)	125.0 ± 1.6	120.3 ± 1.6	4.668	< 0.05
No	Test	Before experiment (n=5)	After experiment (n=5)	t	p
		Female			
		Mean ± SD	Mean ± SD		
1	25m freestyle (s)	14.4 ± 0.8	13.8 ± 0.6	3.522	< 0.05
2	50m freestyle (s)	29.5 ± 0.8	28.5 ± 0.8	3.961	< 0.05
3	200m main swimming subject (s)	140.5 ± 2.3	135.1 ± 2.0	2.885	< 0.05
4	10x50m freestyle swimming (walk and rest 45') (s)	360.0 ± 3.3	346.7 ± 3.6	2.860	< 0.05
5	6x200m swimming, walk and rest, count the final record (s)	145.0 ± 1.5	140.4 ± 1.7	4.530	< 0.05

($t_{\text{standard}} = 2.776$)

Achievements in 5 assessment tests of the experimental group at the time before and after the experiment, using the self-comparison method, all had positive differences, the achievement measured by second decreased. For the experimental group, the performance at the 5 tests examined the difference significantly at the threshold of probability $p < 5\%$ for the male and female athletes.

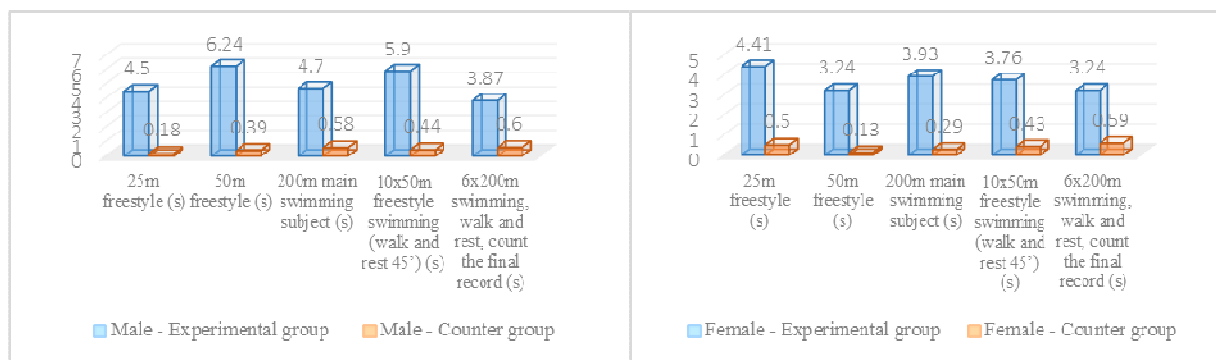
Going one step further, Browdy's index was used to evaluate the growth rate of pre- and post-experimental achievements of the control and experimental groups, the results are presented in Table 8.

Table 8. Growth rate of achievement development of athletes from the experimental and counter group after 6 months

group after 6 months									
No	Test	Experimental group			Control group				
		Before	After		W %	Before	After		W %
		Male		Male					
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD		Mean $\pm$ SD			
1	25m freestyle (s)	11.1 $\pm$ 0.7	10.6 $\pm$ 0.7	4.50	11.1 $\pm$ 0.7	11.1 $\pm$ 0.8	0.18		
2	50m freestyle (s)	25.6 $\pm$ 1.2	24.1 $\pm$ 1.2	6.24	25.5 $\pm$ 1.2	25.4 $\pm$ 1.2	0.39		
3	200m main swimming subject (s)	120.7 $\pm$ 2.3	115.2 $\pm$ 2.1	4.70	120.8 $\pm$ 2.2	120.1 $\pm$ 2.2	0.58		
4	10x50m freestyle swimming (walk and rest 45') (s)	320.0 $\pm$ 3.8	301.7 $\pm$ 3.7	5.90	317.9 $\pm$ 3.8	316.5 $\pm$ 3.8	0.44		
5	6x200m swimming, walk and rest, count the final record (s)	125.0 $\pm$ 1.6	120.3 $\pm$ 1.6	3.87	124.9 $\pm$ 1.6	124.2 $\pm$ 1.6	0.60		
No	Test	Experimental group			Control group				
		Before	After		W %	Before	After		W %
		Female		Female					
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD		Mean $\pm$ SD			
1	25m freestyle (s)	14.4 $\pm$ 0.8	13.8 $\pm$ 0.7	4.41	14.1 $\pm$ 0.7	14.0 $\pm$ 0.5	0.50		
2	50m freestyle (s)	29.5 $\pm$ 0.8	28.5 $\pm$ 0.8	3.24	29.7 $\pm$ 1.2	29.6 $\pm$ 0.8	0.13		
3	200m main swimming subject (s)	140.5 $\pm$ 2.3	135.1 $\pm$ 2.0	3.93	140.4 $\pm$ 2.2	140.0 $\pm$ 2.0	0.29		
4	10x50m freestyle swimming (walk and rest 45') (s)	360.0 $\pm$ 3.3	346.7 $\pm$ 3.6	3.76	359.1 $\pm$ 3.8	357.5 $\pm$ 3.1	0.43		
5	6x200m swimming, walk and rest, count the final record (s)	145.0 $\pm$ 1.5	140.4 $\pm$ 1.7	3.24	145.1 $\pm$ 1.5	144.2 $\pm$ 1.6	0.59		

Table 8 shows that the growth rate of achievement in all 5 assessment tests of the experimental group is from 3.17 to 5.86% for men and 3.24 to 4.41% for women, which is much higher than the **control** group (from 0.18 to 0.60% for men and 0.13 to 0.59% for women).

To be more intuitive, bar charts have been used to evaluate the performance of pre- and post-experiment of the experimental and **control** groups, the results are presented in the following charts:

**Figure 3. Comparing the growth rate of athletes' achievements between the experimental and control groups after 6 months.**

In summary, with objective conditions such as the training level, the training time of the athletes in both experimental and **control** groups are similar, only differing in the application of speed development exercises, the experiment showed that the swimming speed of the experimental group was much higher than the control group for both males and females. This allows the research to confirm the effectiveness of the selected speed development exercises for the athletes of the national swimming team at Danang National Sports Training Center.

Discussion

The findings of this study support the efficacy of structured speed development exercises in enhancing sprint performance among elite swimmers, particularly within environments characterized by insufficient training resources. The statistically significant improvements observed in the experimental group across all five performance tests affirm the importance of incorporating targeted anaerobic and mixed aerobic-anaerobic training modalities into regular practice programs.

These results are consistent with prior literature emphasizing the role of speed-specific training in short-distance swimming events (Maglischo, 2003; Aspenes & Karlsen, 2012). Notably, the intervention's success within a resource-limited setting demonstrates that effective training outcomes do not necessarily

depend on advanced technology or facilities, but rather on the intelligent design and systematic application of appropriate training contents.

Furthermore, a comparative analysis of the post-training results with national athletes from Can Tho and Ho Chi Minh City revealed that the Danang group achieved superior improvements across all sprint tests. Hypothetical performance data suggested a 3.5–6.2% enhancement in the experimental group compared to marginal improvements ($\leq 1\%$) in the non-intervention groups. This reinforces the practical applicability and replicability of the training protocol.

Despite its strengths, the study has limitations, including a relatively small sample size and the absence of physiological markers such as lactate threshold or $\text{VO}_{2\text{max}}$, which could offer deeper insight into training adaptations. Future studies may benefit from including a more diverse athlete pool and exploring long-term effects across multiple competitive seasons.

In conclusion, the results provide strong evidence for the integration of scientifically selected speed training exercises into national-level swimming programs, especially in settings where access to high-tech facilities is limited. The proposed model offers a replicable framework for coaches aiming to optimize sprint performance under similar training conditions.

The study also highlights the value of expert-informed exercise selection, as 29 exercises were identified and validated through interviews with national-level coaches and specialists. These exercises ensured a comprehensive approach to sprint training, balancing endurance, strength, and neuromuscular control. Furthermore, the six-month training period was sufficient to induce measurable adaptations, suggesting that even medium-term interventions can lead to tangible improvements in elite-level performance.

Conclusion

This study confirms that a scientifically grounded approach to selecting and applying speed development exercises significantly enhances sprint performance among national-level swimmers. The six-month intervention program, designed based on expert consensus and structured according to energy system demands, resulted in statistically significant improvements across all performance tests compared to the control group. These findings highlight the value of structured, periodized speed training programs in competitive swimming.

From a theoretical perspective, the study contributes to the limited body of literature on targeted sprint training in swimming within resource-constrained environments. It offers a scientific framework for categorizing speed exercises according to energy systems—anaerobic, aerobic, and mixed—and establishes clear principles for exercise selection that can guide future research and coaching methodologies.

Practically, the study recommends a replicable, context-appropriate model for national training centers. It demonstrates that high-level performance gains are achievable without the need for advanced technologies or facilities, provided that training is evidence-based and systematically implemented. This model is particularly relevant for developing countries seeking cost-effective strategies to enhance elite athletic performance. The findings can directly inform coaching practices, athlete development programs, and national sports policy, helping bridge the gap between potential and performance in Vietnam's competitive swimming context.

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