

## The Impact of a 70-Day Speed, Agility, and Quickness (SAQ) Intervention on Sprint Performance in Pre-Adolescent Swimmers

Muhammad Raza<sup>1</sup>, Shi Hongjie<sup>2</sup>, Harmasheva Yullia<sup>3</sup>, Li Ming Frank<sup>4</sup>, Dr. Saleem Pervaiz Bajwa<sup>5</sup>

<sup>1</sup> Research Scholar at Department of Physical Education and Sports Coaching, majoring in Theory and Practice of Sports Coaching at Capital University of Physical Education and Sports, Beijing, China. Email: [razasandhal12@gmail.com](mailto:razasandhal12@gmail.com)

<sup>2</sup> Associate Professor and Director of the School of Sports Training Teaching and Research Office, Capital University of Physical Education and Sports, Beijing, China. Email: [shihongjie@cupes.edu.cn](mailto:shihongjie@cupes.edu.cn)

<sup>3</sup> Research Scholar at Department of Physical Education and Sports Coaching, majoring in School Physical Education at Capital University of Physical Education and Sports, Beijing, China. Email: [Ugarmasheva96@gmail.com](mailto:Ugarmasheva96@gmail.com)

<sup>4</sup> Head of the Coaches Department at Ocean Star International Swimming and Growth Club Chang-Ping Beijing, China. Email: [wncnlm@vip.qq.com](mailto:wncnlm@vip.qq.com)

<sup>5</sup> Professor at Abbottabad International Medical College, Abbottabad. Email: [brigspbajwa@gmail.com](mailto:brigspbajwa@gmail.com)

**DOI:** <https://doi.org/10.63163/jpehss.v4i1.1123>

### Abstract

The purpose of this investigation was to examine the effects of a 70-day Speed, Agility and Quickness (SAQ) training programme on swimming performance for pre-adolescent male swimmers associated with a swimming club in Beijing, China. Twenty male swimmers, consisting of 10 male swimmers aged under 10 years and 10 male swimmers aged under 12 years, participated in the study. Using a one-group, repeated measures design, all swimmers incorporated SAQ training into their regular swim training schedule, participating in five SAQ training sessions per each 10-day period throughout the 70-day intervention period. Each SAQ training session lasted between 20 and 25 minutes, and performance was measured by a 100-metre sprint time, collected at each 10-day interval from baseline (day 1) to completion of the study (day 70). Repeated measures analysis of variance (ANOVA) indicated a statistically significant overall improvement in swim times during the study ( $F = 155.689$ ,  $p < 0.001$ , partial  $\eta^2 = .876$ ) with no difference between baseline (day 1) and follow-up (day 10) ( $p = 1.000$ ), while statistically significant improvements were shown by day 20 (mean difference [MD] = .401,  $p = .007$ ) and continued to day 70 with the largest improvements recorded (MD = 2.531,  $p < 0.001$ ) across all 4 data collection points in both age groups. The results of this study indicate that a structured (scientifically based) 70-day (approximately 2.5-month) SAQ programme significantly enhances 100-metre sprint performance in pre-adolescent swimmers. The results of this investigation suggest that the use of SAQ strength training methods leads to improved muscular coordination (more cohesive and quicker). Therefore, the establishment of strength through the use of modalities such as SAQ at an early age will produce successful athletes. Coaches should consider combining aquatic and non-aquatic strength training with swimming training in order to facilitate performance gains at an accelerated rate, and to produce faster performance gains with earlier initiation of such training than later initiation.

**Keywords:** Speed, Agility, Quickness (SAQ); Pre-adolescent swimmers; Sprint performance; 100-meter freestyle

## **Introduction**

Around the world, coaches now see (SAQ) speed, agility, and Quickness as key factors in doing better during games. In soccer, basketball, and running events, teams train with organized SAQ routines - results show quicker bursts, stronger bursts, and sharper body control (Anwer et al., 2021; Hadi Al-Husseini; Hamdoon, 2022). When it comes to competitive swimming - where times differ by just tiny bits - turning land-based strength into water performance matters more than usual.

Starting dives, turns, and short sprints in swimming? SAQ training builds key skills - how muscles and movements work together fast. It also sharpens quick responses, plus the power boost from sudden jumps or pushes. For younger swimmers just before they become teenagers, such workouts can make a real difference. That phase - when bodies start shaping strong habits - is vital for **learning full range of physical skills.**

Even though work looks at SAQ coaching in teen and older swimmers worldwide, there is little on kids just before puberty who swim. Across Asia, youth aquatic camps are booming, with teams pushing rivalry training right away. Yet despite that rise, clear rules backed by research on mixing SAQ into standard pool routines for younger athletes hardly exist. This research seeks to fill that space by running a clear, 70-day SAQ program at a neighborhood swim club in China, offering findings tied to local realities while connecting across borders.

## **SAQ Training in Swimming**

When it comes to swimming, movements like agility work differently in the sport. Shifting direction fast during turns defines agility here. Quickness means starting actions quickly, staying sharp even when tired, especially at high stroke speeds. At the core, speed shows up as raw power and precise muscle timing.

Jump-based exercises along with drills tied directly to sport focus form the foundation of SAQ methods, building speed at which strength is applied while boosting takeoff and glide precision off barriers (Soni & Vedawala, 2022). Studies across global athletic settings show well-organized SAQ routines lift speed work, quick changes of direction, and leg drive intensity in young competitors (Anwer et al., 2021). When woven into swimming routines, such training helps channel land-based strength into better performance in the water, closing the divide between broad athletic growth and swim-specific results. Some Chinese swimming clubs now include SAQ ideas in their work. Yet most efforts aimed at young athletes remain untested or inconsistent. When coaches apply proven SAQ methods, results improve - this also builds firmer research roots in early-stage swimming growth.

## **Physiological and Theoretical Basis**

The efficacy of SAQ training is explained on the basis of physiologic and neural premises. Short effort, high intensity efforts like those needed for swimming sprints are primarily powered by the phosphagen (ATP) energy system which gives us adequate ATP to perform maximally over 10–30 seconds—a perfect match to 100-meter freestyle racing.

Neuromuscular mechanisms after SAQ training have been demonstrated to increase motor unit recruitment, synchronization and reactivity of the stretch-shortening cycle (Prieske et al., 2016). Such adjustments are in line with Neuromuscular Coordination Theory, which underscores the role of optimizing neural input for movement efficiency. In addition, such training primarily involves the activation of fast-twitch (Type II) muscle fibers which are critical for power production during starts and turns along with sprint durations (Kumar, 2018). Furthermore, for swimmer performance it is also important that specific SAQ training may lead to improved proprioception, core stability and body alignment allowing athletes better deviate from their enveloping shape thereby reducing hydrodynamic drag which results in enhanced stroke

efficiency (Garcia-Hermoso et al., 2020). These physiological and theoretical foundations encourage SAQ exercises in pre-adolescent swimming program.

### **SAQ Training in Pre-Adolescent Swimmer**

The Developmental Considerations for Pre-Adolescent Swimmers – Children 10 to 12 Years of Age. Pre-adolescence is when training programs for young athletes should focus on coordination, skill development, and Neuromuscular Adaptions rather than on the development of maximal strength. Pre-adolescent children show significant improvements to their performance based upon the application of SAQ and other forms of physical training targeting reaction and responsiveness, as well as fundamental movement and neuromuscular coordination.

Research supports the use of SAQ training in improving speed, power, and agility in young athletes and thus improving physical readiness for sport participation (Yin 2023; Liu, et. al., 2023). Land-Based and Water-Based SAQ training create improvements in stroke mechanics, turn efficiency, and sprint performance, (Silva, et. al. 2022). The utilization of a structured program centred on SAQ training for young swimmers will create a sound foundation for further athletic training and success during the adolescent years when competing.

### **Why do we do this study?**

Although it has been noted that SAQ training has many benefits, there has been limited research on the long-term structured SAQ approaches to train pre-adolescent swimmers and this is also true within the Chinese context. Most of the SAQ research that has been done applies to adolescent or adult populations, the majority of the studies that have included SAQ also had factors such as including SAQ with another type of training or using general as opposed to swimming-specific athletic assessments. Furthermore, **there is virtually no evidence examining the isolated 70-day SAQ training programme's effect on pre-adolescent swimmers compared to their 100-metre freestyle sprints.**

This study will address the gap in the research by developing a controlled sport-specific SAQ training programme at a local swimming club in suburbs of the Beijing. The outcome of this study will provide coaches with practical knowledge and inform the youth training process along with contributing to the global knowledge of the impact of SAQ training on swimming performance development.

The main purpose this Study and intervention is to evaluate the effects of a 70-day SAQ training program on 100-meter freestyle sprint performance among pre-adolescent swimmers who are competing in swimming races.

The specific objectives of the study are:

1. To evaluate the change in sprint performance for swimmers after going through an SAQ training intervention.
2. To provide recommendations based on evidence from the research for how to incorporate SAQ training into youth swimming.
3. To expand our theoretical understanding of the neuromuscular and physiological changes that occur within pre-adolescent competitive swimmers.

This research combines internationally recognized research with what happens in practice in local swimming pools across Beijing, creating practical and scientific knowledge regarding effective strategies for developing young Pre-adolescent swimmers.

### **Methodology**

#### **1. Participants**

Twenty (20) male sprint-distance swimmers were surveyed for this study. All participants were members of the Ocean Star Swimming Club located in Changping District of Beijing, China and

fell within the USA Swimming age group classifications Under-10 and Under-12. Swimmers had previous experience participating in competitions and had represented their club at domestic competitions organized by the swimming federations in Beijing. The similar competitive background of all participants allowed for a homogeneous sample and addressed variability due to differences in experience level as well as performance level.

Ethical approval for this research protocol has been granted through the School of Sports Training within the Department of Sports Coaching and Training Capital University of Physical Education and Sports in Beijing, China (Approval No: 2025/512–238) as well as written consent from the parents/guardian(s) of all participating children were required prior to data collection beginning.

## **2. Variables**

The objective of this study was to assess the influence of a structured “Speed, Agility, and Quickness” (SAQ) regimen on pre-adolescent, domestically competing, sprint swimmer performance in the pool; swimming performance was defined as the dependent variable while the independent variable was the specific SAQ program that had been created by the researchers and was systematically integrated into each swimmer’s regular training schedule over a total of seventy days; this deprivation of the swimmers’ regular endurance-based training was done with the assistance of five dedicated SAQ sessions coming from each ten-day training plan, with each session containing an approximate duration of twenty to twenty-five minutes; throughout the seventy-day period of SAQ training, the training-load for the SAQ intervention was incrementally increased by systematically manipulating both the volume and intensity of each SAQ session in compliance with recommended patterns for the development of neuromuscular and speed-related performance capacities in youth swimmers (Morouço et al., 2012; Amaro et al., 2017), and has previously been shown through extensive research to enhance both neuromuscular coordination and sprint-specific performance in competitive swimming populations (Aspenes & Karlsen, 2012); in addition, in order to isolate any extraneous effects caused by other variables (i.e., other than SAQ) on swimming performance, the swimmers engaged in a concomitant training program (endurance training) which was also part of their standard organisation’s typical operating procedure and this component of the swimmers’ endurance training program was continuously monitored and kept at an equal level for the duration of the study; therefore, by controlling for these external variables, the researchers were able to eliminate possible confounding variables and thus allow for the internal validity of this study; ultimately, these variables will also aid in providing an accurate assessment of the effects of the SAQ interventions on performance outcome measures related to the swimmers’ sprint swimming ability.

## **3. Study Design**

The authors used a single group, repeated measures design to observe changes in swimming performance throughout the training period (Thomas, Nelson & Silverman, 2015). Swimming performance was assessed using a 100 m freestyle time trial (with performance time measured in seconds) (Maglischo, 2003). Prior to the commencement of the training program, the experimental group's baseline performance was measured (pre-test) and once again at 10-day intervals during the 70-day intervention (Barbosa et al., 2010). As such, the design allows for continuous monitoring of performance progression over time. However, given that this study utilized a single group repeated measures design with no control group, any improvement observed in swimming performance cannot be solely attributed to the SAQ training intervention and could also be attributed to maturation, regular swim practice, or other external factors.

### Administration of the training programme

The Swim and Gym Point, Strength and Conditioning Arena of the Ocean Star Swimming Club in Changping, Beijing, was where the Training Programme was held. Training sessions occurred in the afternoon from 4:30 PM - 5:45 PM and were through a total of 70 days.

Each training session was 75-90 minutes in length and was focused on providing quality, purposeful activity appropriate for the age group. The training structure was as follows:

1. Speed, Agility & Quickness (20-25 Minutes): The SAQ Component was performed first to ensure the participants are fresh, and it focused on developing speed, agility, and quickness by having participants engage in fun, high-quality activities.
2. Transition/Active Recovery (10 Minutes): This component allowed for light physical activity, stretching, and rehydration for recovery of the body and for preparing for the Swimming Component.
3. Swimming Component (45-55 Minutes): This focused swimming technical practice occurred after the SAQ Component. During this session, participants practised swimming in moderate volume so they could reinforce swimming skills without creating excessive fatigue in their bodies. There were 5 training sessions in 10-day training cycle, with the 10th day of training solely for the purpose of Performance Testing. The SAQ Training Load was modified systematically using different permutations/combinations of sets and repetitions according to a pre-existing schedule. Progressive overload was derived from increasing the SAQ Training Load through a gradual increase in the volume and intensity of the SAQ training program; thus maintaining principles of Training Program Progression.

### Training Schedule of SAQ Drills

The SAQ exercises were created after collaborating with my Research Supervisor and three specialists in the field of Physical Education and Sports Science. The SAQ workout drill combinations are based on accepted practices and principles for developing speed/agility (i.e. Bompa & Haff [2009] and Sheppard & Young [2006]). Using these professionals' recommendations as the basis, a variety of drills were selected and placed into three main category types under SAQ: Speed – Agility – Quickness. All drill-specific details are covered in the following pages.

To maintain an adequate level of increased training stress and to allow for an equal distribution of drills used, seven separate training sets were constructed. Each training set represents many different combinations of three catalogue types over the duration of the 70 day intervention allowing for participants to see all the variations available while having access to complete athletic performance (training) through their highest level of interest.

**Table 1: SAQ Drill Inventory**

Speed Drills	Agility Drills	Quickness Drills
Paw Drill (Stationary Cycling Action)	Crossover Skipping	Tap Drills (Simple Reaction Touches)
“A” Skip	Squirm (Lateral Weave Through Cones)	Medicine Ball Squat, Push Toss, Bounce and Catch
Resisted Stationary “A” Skip	40-Yard Ladder Sprint	Medicine Ball Reverse Scoop Toss, Bounce and Catch
Resisted Stationary “B” Skip	Stand Up from Four Points (Supine)	Plyometric Push-Ups
Light Sled/Tire Pull	Stand Up from a Sitting Position	Medicine Ball Wall Chest Passes

Contrast Sled/Tire Pull	Forward Roll Over Shoulder (Mat) Flip and Catch (Reaction Ball)	Medicine Ball Release Push-Ups with Partner
Stadium Stairs	Toss, Get Up and Catch (Medicine Ball)	Medicine Ball Overhead Throw Foot Tapping Frequency (Maximal Taps in 5s)
Heavy Sled Pulls		

### Sequence of Interventions and Evaluation of Performance

The participants were evaluated for their swimming ability using a 100-meter freestyle swimming performance test, which measured the length of time (in seconds) it took each participant to complete the swim. Participants were evaluated before starting the training program (baseline) and subsequently every 10 days throughout the 70-day intervention period for total of 70 days, which began at the end of summer 2025 and ended at the middle of autumn 2025. The baseline phase of the project began on August 1, 2025, and the 1st set of the training program was completed to provide an initial training stimulus, as well as to evaluate the effectiveness of combining SAQ-determined (speed, agility and quickness) drills with swimming training.

During the 70-day intervention period, swimming performance was tested at 10-day intervals in order to assess how swimming performance changed over time after completing the training. Each of the testing sessions (10-day intervals) occurred on the 10th, 20th, 30th, 40th, 50th, 60th and 70th training days. The midpoint of the 70-day intervention was on September 4th, 2025 (day 40) which occurred at Set IV of the training program and served as a formative assessment of the intermediate adaptations and cumulative effects of the training before progressing to the final 30 days of the training program.

The 70-day intervention ended on October 9th, 2025 (day 70) completing Set VII of the training program and serving as the summative assessment. The final performance testing conducted on this date included measuring the overall impact of the training program on the swimming performance of the participants in relation to improvements in speed-related outcomes.

The assessment of swimming performance was completed based on manual timekeeping by each participant in three separate independent timekeeping sessions. Each performance time was recorded to the nearest 1/100th of a second, and the average of the three times recorded for each testing session was used for statistical analysis.

### Collection of Data

Collecting and analyzing data were an integral part of evaluating the success of the SAQ training program for enhancing swimming performance. A systematic approach to collecting data allowed for changes in the level of swimming performance to be measured over the course of the experimental duration of the study. After establishing a baseline level prior to initiating the experimental condition, the investigator regularly collected performance data throughout the experimental duration on every tenth day. By utilizing a repeated-measures approach to measuring performance over time, an ongoing record of performance changes could be established and evaluated based on measurements taken throughout the entire duration of the study.

### Statistical Technique

Performance data were analyzed using the 2021 version of SPSS. Measures of central tendency (mean) and measures of variability (standard deviation) were calculated to summarize performance data at each testing interval. A repeated measures ANOVA was utilized to test for differences between swimming performances across multiple testing occasions with a Greenhouse–Geisser correction (when applicable) made for violation of sphericity. Results were reported as statistically significant at an alpha level of  $p < 0.05$ . If a statistically significant main

effect occurred, than a Bonferroni-adjusted pairwise comparisons analysis was performed to determine at which specific testing time points a statistically significant difference occurred. Effect size was calculated using the partial eta squared ( $\eta^2$ ) statistic to evaluate effect size. Evaluation of data utilizing this analytical technique increased the validity and interpretability of the study results.

## Results

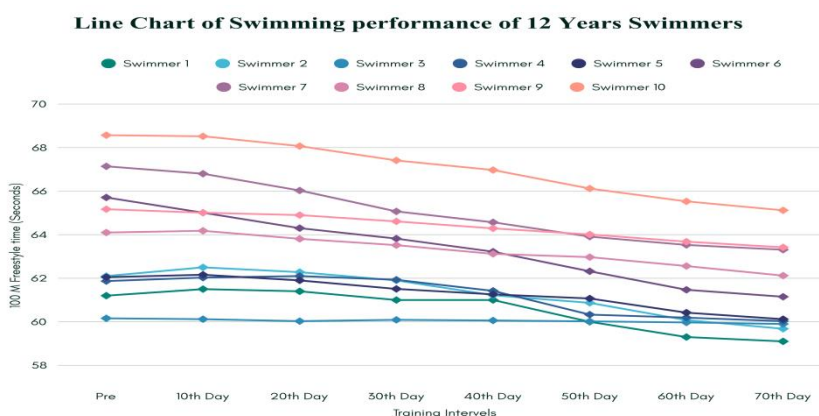
This study's objective was to determine whether SAQ drills (Speed, Agility, and Quickness) positively influenced how fast competitive male swimmers could swim (in seconds) 100 meters (in a competitive environment). Twenty (20) swimmers were selected and divided into two groups based on age (U-12 n=10; U-10 n=10). Swimming performance was recorded as time taken (in seconds) to complete one (1) 100-meter race in freestyle and assessed three times during each 10-day SAQ training intervention (total of 7 assessments during the scheduled 70 days of SAQ training). Figure 1 presents data for swimming performance across all measurement points. Both groups (i.e., U-10 and U-12) experienced an increase in swimming performances as shown by consistently decreasing average finishing times throughout the entire study period. Figure 2 presents data regarding average finishing times for both groups of competitors (i.e., U-10 and U-12).

**Table 2:**  
**Swimming Performance (100 m Freestyle Time in Seconds) for Under-12 and Under-10 Age Groups Before and During the SAQ Intervention (Mean  $\pm$  SD).**

Time Point	Under-12 (n=10)	Under-10 (n=10)
Pre-test	64.01 $\pm$ 2.65	69.75 $\pm$ 3.17
10th day	63.93 $\pm$ 2.59	69.79 $\pm$ 3.11
20th day	63.58 $\pm$ 2.42	69.35 $\pm$ 2.95
30th day	63.06 $\pm$ 2.15	68.66 $\pm$ 2.74
40th day	62.62 $\pm$ 1.93	68.17 $\pm$ 2.56
50th day	61.92 $\pm$ 1.99	67.61 $\pm$ 2.55
60th day	61.28 $\pm$ 1.91	67.13 $\pm$ 2.47
70th day	60.94 $\pm$ 1.87	66.69 $\pm$ 2.45

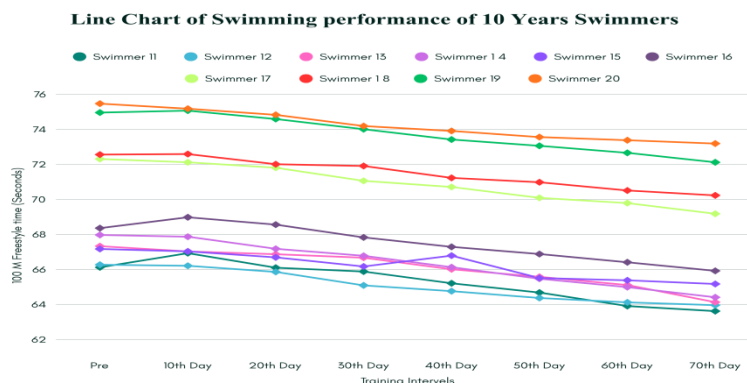
Note: SD = Standard Deviation. Lower times indicate better performance.

The trend of swimming performance improvement across the intervention period for Under-12 swimmers is illustrated in **Figure 1**.



**Figure 1 : Changes in 100 m freestyle performance in Under-12 swimmers**

Changes in 100 m freestyle swimming performance over time for Under-10 swimmers are depicted in Figure 2.



**Figure 2: Changes in 100 m freestyle performance in Under-10 swimmers**  
**Within-Subjects and Between-Subjects Effects**

The repeated-measures ANOVA revealed a statistically significant within-subjects effect of Trial on swimming performance Table 3. As Mauchly's test indicated a violation of the sphericity assumption, the Greenhouse–Geisser correction was applied. The corrected results showed a significant effect of Trial on swimming performance ( $F = 155.689$ ,  $p < 0.001$ ), with a large effect size (partial  $\eta^2 = 0.876$ ), indicating that swimming performance differed significantly across the measurement occasions.

The **between-subjects effects analysis** Table.4 indicated a statistically significant **intercept effect** ( $F = 6321.639$ ,  $p < 0.001$ ; partial  $\eta^2 = 0.997$ ). This result reflects the presence of a substantial overall mean level of swimming performance across participants and represents the grand mean of the repeated measures rather than differences between individuals or experimental conditions. The repeated-measures ANOVA revealed a statistically significant change in swimming performance across the measurement occasions, as indicated by the within-subjects effect of Trial ( $p < 0.001$ , partial  $\eta^2 = 0.876$ ). These findings indicate that swimming performance improved progressively over time during the 70-day SAQ training period. However, as the study employed a single-group repeated-measures design without a control group, the observed improvements should be interpreted as time-related performance changes occurring during the intervention period rather than as definitive causal effects of the SAQ training programme. The results of the repeated-measures ANOVA examining changes in swimming performance across trials are summarized in **Table 3**. The between-subjects effects for swimming performance are presented in **Table 4**.

Table 3 : Tests of Within-Subjects Effects for Swimming Performance

Source	Correction Method	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial $\eta^2$
Trial	Sphericity Assumed	154.664	7.0	22.095	155.689	<.001	0.876
	Greenhouse–Geisser	154.664	1.8	82.613	155.689	<.001	0.876
	Huynh–Feldt	154.664	2.0	75.818	155.689	<.001	0.876
	Lower-Bound	154.664	1.0	154.664	155.689	<.001	0.876

Source	Correction Method	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial $\eta^2$
<b>Error (Trial)</b>	Sphericity Assumed	21.855	154.0	0.142	—	—	—
	Greenhouse–Geisser	21.855	41.1	0.531	—	—	—
	Huynh–Feldt	21.855	44.8	0.487	—	—	—
	Lower-Bound	21.855	22.0	0.993	—	—	—

Table:4 Tests of Between-Subjects Effects for Swimming Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial $\eta^2$
<b>Intercept</b>	793,770.386	1	793,770.386	6321.639	< .001	0.997
<b>Error</b>	2,762.409	22	125.564	—	—	—

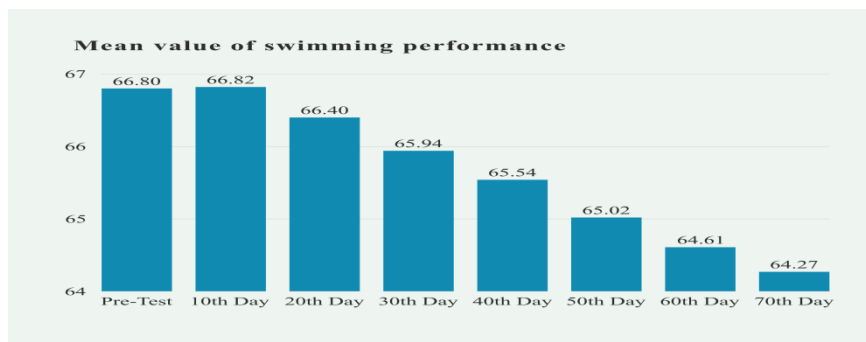
### Post Hoc Test

Post hoc analyses were conducted to evaluate changes in swimming performance across eight measurement intervals. There was no difference to be found between the line of the Pre-test to line of 10th day (Mean Difference = -0.015,  $p = 1.000$ ). However, compared to Pre-test, by the end of the 20th day, performance had significantly improved (Mean Difference = 0.401,  $p = 0.007$ ), and also compared to the 10th day (Mean Difference = 0.416,  $p < 0.001$ ). As with the previous day, performance continued to make linear gains with the 30th day demonstrating significant improvements over the Pre-test (Mean Difference = 0.862), over the 10th day (Mean Difference = 0.877), and 20th day (Mean Difference = 0.461), with each of these comparisons  $p < 0.001$ . The same trend can be seen across all measures of the SAQ drills training with every point beyond the initial trial being a greater improvement than all previous ones aside from the comparison of the Pre-test and Day 10, and culminating in the largest improvement from the Pre-test to Day 70 (Mean Difference = 2.531,  $p < 0.001$ ). The consistency of results whereby each trial surpassed all earlier trials except for the comparison between the Pre-test and Day 10 provides confirmation that the SAQ drills training resulted in significant and cumulative improvements in swimming performance, with peak performance having been achieved by the end of the 70th day. Table 5 displays the pairwise post-hoc comparisons of swimming performance among trials compared to the Pre-test.

Table 5: Table of Mean Differences vs. Pre-test

Trial	Mean Difference (vs. Pre-test)	Std. Error	p-value
10th day	-0.015	0.072	1
20th day	0.401	0.091	0.007
30th day	0.862	0.124	<0.001
40th day	1.261	0.141	<0.001
50th day	1.779	0.156	<0.001
60th day	2.194	0.168	<0.001
70th day	2.531	0.181	<0.001

Mean improvement in swimming performance across the 70-day training period for all participants is shown in Figure 3



**Figure:3 Mean Value of swimming performance of all subjects**

## Discussion

A 70-day structured Speed, Agility, Quickness (SAQ) training program was developed and assessed to improve 100-meter freestyle sprint performance of male pre-adolescent swimmers. The results of this study suggest a statistically significant increase in swimming performance over the duration of the intervention; therefore, as athletes progressed through the different intervals of testing, the mean completion time decreased overall. For this group, initial improvements from the pre-test to Day 10 exhibited limited changes. However, from Day 20 onward, a steady rate of improvement occurred in a linear fashion that reached optimal performance by Day 70. These results corroborate findings from past studies indicating that structured SAQ training results in improved sprint performance for youth athletes (Sheppard and Young, 2006; Moran et al., 2018). Performance enhancements observed by the not only can be attributed to the application of the Neuromuscular Coordination Theory. Thickening of the neural signal improves motor unit recruitment and eventually results in more efficient movement patterns as a result of SAQ training (Baron and Haff, 2009; Behm and Sale, 1993). The adaptations made as a result of SAQ training in pre-adolescent swimmers are central to helping with the development of rapid and powerful propulsion during start dives, turns, and push-offs from the wall. Fast-twitch muscle fibers (Type II), necessary for producing maximal force/effort over short durations, are enhanced through high-intensity drilling, ideally suited for 100-meter freestyle swimming.

Improvements in efficiencies by using a stretch-shortening cycle will enhance both the amount of propulsive forces generated and the speed of the stroke being performed (Markovic, 2007). Having effective land-based SAQ exercises such as plyometric push-ups, medicine ball throws, and ladder footwork, facilitated the transfer of strength, power and coordination onto in-water performance maximally. Thus, by integrating exercises that enhance core stability (alignment), body alignment and reactive strength, land-based SAQ drills can minimize hydrodynamic drag while improving swimming efficiency (Aspenes and Karlsen, 2012; Tanaka and Swensen, 1998). These results indicate that there is utility for incorporating land-based SAQ interventions in conjunction with ongoing daily swimming, especially in instances where youth athletes require structured, developmentally appropriate conditioning (Faigenbaum et al., 2009).

Despite the promising results of this study, there are limitations to note. This investigation used a single group, repeated-measures design which limits the potential for causal inferences to be drawn since a control group was not employed. Also, natural growth and maturation during the time frame were other potential factors that contributed to the improvements; there can also be, to some extent, other environmental factors (Lloyd and Oliver, 2012). In addition, due to the small, homogeneous sample (20 male swimmers from a single club in Beijing) the results may not generalize to other demographically diverse groups such as female swimmers or those performing at different levels of competitiveness.

For practical application, the results of the study provide a foundation for coaches and athletic trainers developing programs for pre-adolescent swimmers. The results of the study indicate that

a 70-day structured SAQ program with 20-25 minutes of quality practice will result in improved sprint performances within pre-adolescents. Given that this age group is in the “sensitive period” for motor skill development (Lloyd & Oliver, 2012), the focus should center on improving neuromuscular coordination and reactive strength over building maximal strength. Coaches should schedule the performance of SAQ workouts first in the training sessions to enable greater execution, neural adaptation and skill transfer.

### Conclusion

The current study found that a 70-day SAQ training program greatly improved a pre-adolescent male swimmer’s performance in the 100m freestyle. There were no noticeable changes to performance during the first 10 days, but consistent cumulative improvements began to show on day 20 and continued to improve through day 70, with an average improvement of 2.531 seconds from baseline.

These results support the theory that dry-land training (speed and high intensity) will have neuromuscular adaptations to the body of young athletes. As young swimmers train their body using SAQ drills, they will improve their motor unit recruitment, maximise their use of the stretch-shortening cycle, and encourage the fast-twitch muscle fibre activation in Type 2 fibres in a swimmer’s body, allowing explosive dry-land power to be converted into improved velocity in the water.

This form of training will enhance motor skill acquisition and coordination for swimmers aged 10 and younger or 12 and younger. SAQ drills are a good addition to any youth swimming program and offer a practical and evidence-based method of improving sprint performance. Although the study was conducted with only one group, as evidenced by the linear progression of improvement shown in the data, the performance benefits of SAQ training for a pre-adolescent swimmer are considerable. The information provided in this study can be implemented by coaches in China and all countries to help close the gap between general athletic preparation and swimming-specific performance development.

### References

- Amaro, N. M., Marques, M. C., Barbosa, T. M., & Morouço, P. (2017). The effects of dry-land strength and power training on swimming performance. *Sports Medicine - Open*, 3(1), 23. [<https://doi.org/10.1186/s40798-017-0089-0>](<https://doi.org/10.1186/s40798-017-0089-0>)
- Anwer, U., Nuhmani, S., Sharma, S., Bari, M. A., Kachanathu, S. J., & Abualait, T. S. (2021). Efficacy of speed, agility, and quickness training with and without equipment on athletic performance parameters: A randomized control trial. *International Journal of Human Movement and Sports Sciences*, 9(2), 194–202. [<https://doi.org/10.13189/saj.2021.090205>](<https://doi.org/10.13189/saj.2021.090205>)
- Aspenes, S. T., & Karlsen, T. (2012). Exercise-training intervention studies in competitive swimming. *Sports Medicine*, 42(6), 527–543.
- Behm, D. G., & Sale, D. G. (1993). Intended rather than actual movement velocity determines velocity-specific training response. *Journal of Applied Physiology*, 74(1), 359–368. [<https://doi.org/10.1152/jappl.1993.74.1.359>](<https://doi.org/10.1152/jappl.1993.74.1.359>)
- Bompa, T. O., & Haff, G. G. (2009). *Periodization: Theory and methodology of training* (5th ed.). Human Kinetics.
- Costa, M. J., Marinho, D. A., Reis, V. M., Silva, A. J., Marques, M. C., & Bragada, J. A. (2010). Tracking the performance of world-ranked swimmers. *Journal of Sports Science & Medicine*, 9(3), 411–417.

- Faigenbaum, A. D., Kraemer, W. J., Blimkie, C. J., Jeffreys, I., Micheli, L. J., Nitka, M., & Rowland, T. W. (2009). Youth resistance training: Updated position statement paper from the National Strength and Conditioning Association. *Journal of Strength and Conditioning Research*, 23(5 Suppl), S60–S79.
- Hadi Al-Husseini, M. S., & Hamdoon, M. (2022). The effect of S.A.Q training style on a number of basic skills for futsal players. *Al-Rafidain Journal for Sport Sciences*, 25(76), 109–136. [<https://doi.org/10.33899/rjss.2022.173592>](<https://doi.org/10.33899/rjss.2022.173592>)
- Henneman, E. (1957). Relation between size of neurons and their susceptibility to discharge. *Science*, 126(3287), 1345–1347. [<https://doi.org/10.1126/science.126.3287.1345>](<https://doi.org/10.1126/science.126.3287.1345>)
- Khiyami, A., Nuhmani, S., Joseph, R., Abualait, T. S., & Muaidi, Q. (2022). Efficacy of core training in swimming performance and neuromuscular parameters of young swimmers: A randomized control trial. *Journal of Clinical Medicine*, 11(11), 3198. [<https://doi.org/10.3390/jcm11113198>](<https://doi.org/10.3390/jcm11113198>)
- Kumar, R. (2018). The effects of speed, agility, and quickness training on swimming performance. *Journal of Athletic Enhancement*, 7(3), 1–6. [<https://doi.org/10.4172/2324-9080.1000289>](<https://doi.org/10.4172/2324-9080.1000289>)
- Lloyd, R. S., & Oliver, J. L. (2012). The youth physical development model: A new approach to long-term athletic development. *Strength and Conditioning Journal*, 34(3), 61–72. [<https://doi.org/10.1519/SSC.0b013e31825760ea>](<https://doi.org/10.1519/SSC.0b013e31825760ea>)
- Maglischo, E. W. (2003). *Swimming fastest: The essential reference on technique, training, and program design* (Rev. ed.). Human Kinetics.
- Markovic, G. (2007). Does plyometric training improve vertical jump height? A meta-analytical review. *British Journal of Sports Medicine*, 41(6), 349–355. [<https://doi.org/10.1136/bjism.2007.035113>](<https://doi.org/10.1136/bjism.2007.035113>)
- Moran, J., Sandercock, G., & Ramírez-Campillo, R. (2018). The effect of plyometric training on youth athletic performance: A meta-analysis. *Journal of Sports Sciences*, 36(9), 1026–1034. [<https://doi.org/10.1080/02640414.2017.1340640>](<https://doi.org/10.1080/02640414.2017.1340640>)
- Morouço, P., Marinho, D. A., Neiva, H. P., & Barbosa, T. M. (2012). Effects of dry-land strength training programs on swimming performance: A systematic review. *Journal of Sports Science & Medicine*, 11(3), 433–441.
- NASM. (2026). Understanding fast-twitch vs slow-twitch muscle fibers. National Academy of Sports Medicine. [<https://www.nasm.org/resource-center/blog/understanding-fast-twitch-vs-slow-twitch-muscle-fibers>](<https://www.nasm.org/resource-center/blog/understanding-fast-twitch-vs-slow-twitch-muscle-fibers>)
- Sale, D. G. (1988). Neural adaptation to resistance training. *Medicine & Science in Sports & Exercise*, 20(5 Suppl), S135–S145.
- Sheppard, J. M., & Young, W. B. (2006). Agility literature review: Classifications, training and testing. *Journal of Sports Sciences*, 24(9), 919–932. [<https://doi.org/10.1080/02640410500457109>](<https://doi.org/10.1080/02640410500457109>)
- Si, X., Liu, Y., Feng, X., & Feng, S. (2025). Experimental study on the impact of speed-agility-quickness training on the agility performance of collegiate sanda athletes. *PeerJ*, 13, e19406. [<https://doi.org/10.7717/peerj.19406>](<https://doi.org/10.7717/peerj.19406>)

- Soni, V., & Vedawala, N. (2022). Effectiveness of plyometric exercises to improve speed and agility in young beginner swimmers: A randomized control trial. *International Journal of Research and Review*, 9, 89–95. [<https://doi.org/10.52403/ijrr.20220311>](<https://doi.org/10.52403/ijrr.20220311>)
- Sun, M., Soh, K. G., Cao, S., Yaacob, A. B., Ma, S., & Ding, C. (2025). Effects of speed, agility, and quickness training on athletic performance: A systematic review and meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, 17, 66. [<https://doi.org/10.1186/s13102-025-01101-w>](<https://doi.org/10.1186/s13102-025-01101-w>)
- Tanaka, H., & Swensen, T. (1998). Impact of resistance training on endurance performance. *Sports Medicine*, 25(3), 191–200. [<https://doi.org/10.2165/00007256-199825030-00005>](<https://doi.org/10.2165/00007256-199825030-00005>)
- Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2015). *Research methods in physical activity* (7th ed.). Human Kinetics.
- Trecroci, A., Cavaggioni, L., Rossi, A., Moriondo, A., Merati, G., Nobari, H., & Formenti, D. (2022). Effects of a speed, agility and quickness training programme on cognitive and physical performance in preadolescent soccer players. *PLoS ONE*, 17(12), e0277683. [<https://doi.org/10.1371/journal.pone.0277683>](<https://doi.org/10.1371/journal.pone.0277683>)
- Vandervoort, A. A. (2002). Aging of the human neuromuscular system. *Muscle & Nerve*, 25(1), 17–25. [<https://doi.org/10.1002/mus.1215>](<https://doi.org/10.1002/mus.1215>)
- Zatsiorsky, V. M., & Kraemer, W. J. (2006). *Science and practice of strength training* (2nd ed.). Human Kinetics.