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Construction of Accuracy Speed Agility and Quickness Training Program to Improve Fencing Performance in Young Fencers

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Abstract

Background and Aims: Fencing is a complex sport that highly depends on technique and physical fitness, mainly through the interaction of abilities such as precision, speed, agility, and quick reaction, which significantly impact competitive performance. However, current training methods and approaches for youth fencers still face limitations, including insufficient emphasis on physical training, incomplete understanding of athletes' physical and mental development patterns, and a lack of innovative training methods. These limitations may adversely affect the long-term development of athletes. Therefore, this study aims to develop an ASAQ training program that integrates precision with speed, agility, and quick reaction (SAQ) training to enhance youth fencers' technical skills and physical fitness, thereby improving their competitive performance. Specific objectives include) To conduct an experimental study on the developed program and compare the effectiveness between the experimental group and the control group in terms of physical fitness and fencing skills.2) To compare the effectiveness of the ASAQ training program in improving specific performance aspects of athletes through data analysis, particularly in enhancing lunge accuracy, speed, and reaction times.

Methodology: The study sample consisted of 62 young athletes from the Guangzhou Fencing Team, including 35 males (56.45%) and 27 females (43.55%); based on the scores from basic fencing techniques and physical fitness tests, athletes were sequentially numbered from 1 to 62 in descending order of their scores. They were then divided into two groups using systematic sampling: then drawn into the experimental group (n=31) and the control group (n=31). Research tools consisted of the training program, validated at.95 (.60-1.00), an interview form, a physical fitness test, a fencing skill test, and a program evaluation questionnaire. The experiment was operated thrice a week, two hours a day, for eight weeks. The training was conducted thrice weekly, two hours per session, over eight weeks. Data were collected at the pre-test, mid-test, and post-test for fencing skills and at the pre-test and post-test for physical fitness. The experimental and control group's fencing of skill data were analyzed using repeated measures ANOVA and post hoc with LSD. Comparisons of physical fitness between the experimental and control groups at pre-test and post-test were made using independent t-tests.

Results: ASAQ training significantly improves the basic skills of young fencers, particularly in precise target attack techniques, footwork speed, lunges, and quick responses during offense and defense. The experimental group outperformed the control group in three physical performance metrics: 15 meters Obstacle Sprint, Jump Ropes in One Minute, and Standing long jump. This showed that the ASAQ training improved speed, agility, coordination, balance, and lower body explosiveness, enhancing fencers' short-distance movement, quick directional changes, and explosive attacks during training and competitions.

Conclusion: The findings were as follows: 1) ASAQ could significantly improve the accuracy of target-hitting attack techniques, fencing footwork speed, lunges, and quick reactions during offense and defense of young fencers. It also showed significant improvements in physical qualities such as speed, agility, coordination balance, quick reactions, and lower limb explosive power. 2) The experimental group's post-test was significantly higher than the control group's at.05 on physical fitness and fencing skills. 3) The final interview of experts unanimously affirmed the ASAQ training method's effectiveness in enhancing young fencers' competitive performance. It recognized the practical value of the ASAQ training method. Future studies could integrate objective data such as physiological and biochemical indicators and athletic performance, utilizing scientific tools and equipment like GPS sports tracking systems and other wearable devices for training monitoring to enhance the accuracy of the results.

Keywords: ASAQ Training Program; Fencing Skills; Physical Fitness; Young Fencers

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Introduction

As a sport that highly depends on skills and physical fitness, fencing has increasingly drawn attention to the impact of training methods on performance. Fencing has been proven to rely on various physical qualities, including speed, agility, explosiveness, and anaerobic endurance (Magyar & Oravițan, 2021). In actual combat, offensive actions are vital to winning matches, and fencing characteristics include the speed of hand techniques and the explosiveness of lower limb movements (Amr, 2012). Studies have also found that accuracy, speed, coordination, and quick reactions are the most critical abilities for high-level fencers (Sorel et al., 2019). Therefore, fencers need speed, agility, accuracy, and quick response abilities.

Accuracy was critical in fencing. The ultimate goal of fencing was to accurately and effectively hit the opponent and score points. Some believed that a fencer's "accuracy" was the highest level of a winning factor (Wang & Wang, 2013). Lack of accuracy could result in many attacks that lack competition targets (Al Fattah et al., 2023). Accurate scoring depended on quick actions, consistent body coordination, and the ability to start quickly. Thus, these abilities were interconnected and inseparable. Speed was the core of fencing. It determines how fast athletes move in a match and how quickly they switch between offense and defense. Many scholars consider speed level as one of the most essential characteristics of elite fencers (Agosti & Autuori, 2020). Agility was the foundation of fencing. Fencers needed reasonable control over their bodies to attack, defend, change direction, and evade while maintaining synchronization and coordination of various technical movements. Fencers moved in a straight line between 250 and 1,000 meters and changed direction approximately 400 times per round (Roi & Bianchedi, 2008). Quickness was the soul of fencing. Fencing involves repeated offensive and defensive transitions, and the ability to start and explode quickly allows fencers to respond immediately after the opponent reacts, gaining the advantage to strike the opponent.

Existing research has confirmed that fencing training methods have received widespread attention. Researchers are dedicated to improving the performance of fencers by exploring different training methods, evaluation methods, and innovations in training equipment and practices. However, most studies have focused on adult athletes, with less attention given to the training content for younger athletes. Currently, in the field of fencing training research, many studies focus on 'Speed,' 'Agility,' and 'Quickness' (SAQ) training, emphasizing the development of speed, agility, and quickness to improve various forms of strength, coordination, agility, and speed (Mohamed & Larson, 2018). Some studies have shown that SAQ training methods are more effective during adolescence than in adulthood (Fransen et al., 2012). Through SAQ training, fencers can respond more quickly to stimuli, making their directional changes faster (Young & Farrow, 2006). However, it is worth noting that fencing, a highly technical sport, requires precise aiming at the opponent and scoring hits (McMorris, 2014). 'Accuracy' is the most critical factor for success in fencing. However, there is currently no specific research on the integration of accuracy training with SAQ training in fencing physical training theories.

Therefore, this study attempts to develop a training program focused on "Accuracy," "Speed," "Agility," and "Quickness" (ASAQ training) for young fencers. It aimed to establish the principles of ASAQ training, seize the golden period of physical training for adolescents, and develop and implement a reasonable training program to effectively Improve the athletic performance of young fencers. Additionally, this study hoped to provide applicable training methods and concepts for coaches and training researchers, further enriching the theoretical system of training for young fencers. Additionally, the findings of this study may provide significant reference value for athletes in high-level fencing teams, fencing schools, fencing associations, and institutions.

Objectives

To develop the ASAQ Training Program aimed at improving the overall performance of young fencers and to conduct an experimental study on the program, comparing the effectiveness between the experimental group and the control group in terms of fencing skills and physical fitness.

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Literature Review

Fencing is a sport that highly depends on skill and physical fitness. This study analyzes the common and critical basic techniques and physical fitness indicators in fencing, which many scholars have extensively researched.

The lunge is the most common and essential technical movement in fencing footwork, appearing approximately 140 times per match and 21 times per bout. Therefore, many scholars consider the lunge the fundamental and most critical ability in fencing footwork, which is essential for success (Roi & Bianchedi, 2008; Tsolakis & Vagenas, 2010). Many scholars believe that accurate thrusting ability is the most critical factor for success in fencing, being the highest winning factor (Salah al-Din, 1980; Wang & Wang, 2013). McMorris (2014) discussed the significant impact of accuracy on fencing, stating that accurate and fast attacks and thrusts are the most critical factors for victory in this highly technical and strategic sport. Fencers use proficient offensive and defensive footwork in matches to restrain, control, and evade opponents, forming the basic techniques for winning. According to the Editorial Committee of the "Sports Dictionary" (1984), the advance and retreat steps are the most fundamental and vital offensive and defensive footwork in fencing. The parry technique is an essential defensive movement in fencing. Williams & Walmsley (2000) stated that parry techniques require high muscle coordination and that elite fencers exhibit faster reaction times and better accuracy, effectively blocking the opponent's attacks and making rapid counterattacks. Briskin et al. (2014) emphasized that maintaining good body balance and stability during parries is crucial for defense and counterattacks. Counterattack techniques in fencing involve defensive and offensive actions taken when the opponent attacks. These studies show that every feint or counterattack in fencing involves multiple technical actions, requiring athletes to choose and apply them based on actual situations and improve the effectiveness of each technique through proper training.

Many scholars have conducted in-depth studies on physical fitness in fencing. Magyar and Oravițan (2021) analyzed the physical fitness requirements of fencing, stating that it is a sport with strict demands on speed, agility, explosive power, and anaerobic endurance. Reaction speed and offensive accuracy are indispensable for achieving optimal technique, and they identified reaction speed, movement speed, and displacement speed as the primary forms of speed in fencing. Wang et al. (2007) conducted in-depth research on physical fitness training for fencers, defining specific fitness as various abilities displayed in fencing, including strength, speed, endurance, and agility. The combination of these abilities reflects the athlete's technical level and performance. They discussed the specific characteristics of speed, strength, flexibility, and agility in fencing, emphasizing the interactions between these characteristics. They concluded that comprehensive training in these qualities is essential. Barth & Beck (2006) in "The Complete Guide to Fencing" support the viewpoint on physical fitness training. They investigated the interrelationship of speed, coordination, and strength in fencing and concluded that these qualities are interdependent and inseparable. Accuracy, speed, agility, and quickness may appear independent but are closely related. Mylsidayu and Kurniawan (2015) pointed out that strength is the foundation for developing speed, and agility is closely related to speed and quickness.

Adolescents are in a peak period of growth and development, and there has been ample research describing the physical characteristics, motor functions, athletic performance, and motor development abilities during this period (Jurimae, 2001; Lloyd et al., 2015). Their bones, muscles, and nervous systems are rapidly developing during this stage. According to the Youth Physical Development model proposed by Lloyd et al (2015), speed and agility training should begin early in adolescence. Jeffreys (2006) noted that the most critical period for speed development is during adolescence when neuromuscular control has significant potential for development. Nesen and Klimenchenko (2022) believe that training young athletes during this period is crucial for their future development. They explored the speed and strength indicators of 12-13-year-old novice fencers, indicating that they can develop speed and strength. Mastering these qualities is crucial for developing accuracy, so it is essential to seize the golden period of physical and mental development in youth, conducting scientific training to improve their overall abilities.

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Based on the skill and physical fitness characteristics of fencing, combined with the critical stages of training during adolescent physical development, we have developed an ASAQ training program to enhance young fencers' athletic performance. ASAQ is a comprehensive training method to improve athletes' accuracy, speed, agility, and reaction ability. The ASAQ training theory and principles are based on SAQ training. SAQ is a well-known modern physical training method that gained popularity in American football in the 1980s (Bloomfield et al., 2007). It combines short-distance speed sprints, multi-directional movements under-stimulated and non-stimulated conditions, and the ability to complete quick actions in a short time (Milanović et al., 2013).Amr et al. (2017) noted that SAQ training can improve maximum power capability during high-speed movements and effectively narrow the gap between traditional resistance training and energy system training. SAQ training aims to develop motor skills and physical movements through the nervous system, increasing neuromuscular adaptability, enhancing muscle strength and explosiveness, and improving muscle coordination and reaction time (Latip & Isyani, 2020). Accuracy, speed, agility, and quickness may appear independent but are closely related. Therefore, accuracy, speed, agility, and quickness are interconnected abilities that especially need to be considered in the complex sport of fencing.

Research suggests that the design of training programs is essential in sports training (Kumyaito et al., 2018). Khonturaev (2023) believes that when designing training programs, it is necessary to closely revolve around the specific characteristics and requirements of the sport. In physical fitness and skill training, rest and recovery should be arranged according to the characteristics of sports training, and athletes' physical performance indicators should be monitored and evaluated to detect problems promptly and make corresponding adjustments. The study suggests that when formulating training programs, the training objectives, training content, training subjects, training time, training facilities and equipment, and training evaluation should be carefully considered. Sports training is a complex process, and the creation of training programs relies on the principles of training implementation. Scientific training principles can help athletes maximize their potential. Grosser (2000) pointed out that biological adaptation is achieved through specific training principles in practical application. Many scholars have explored various training principles from different perspectives, including specificity, overload, reversibility, progression, periodicity, individualization, and FITT (Kasper, 2019; França et al., 2022).

In summary, the ASAQ training program developed in this study was based on the principles of SAQ training. It integrated the critical skill of accuracy required in fencing with SAQ training. This approach filled a research gap, provided a reference for coaches to improve training methods, and offered a theoretical basis for researchers. Additionally, when designing and implementing the ASAQ training plan, it was crucial to closely consider the athletes' physical and mental characteristics and fencing levels, arranging the content, load, and training methods appropriately. Strict adherence to training principles was also essential to efficiently enhance the athletic performance of young fencers.

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Conceptual Framework

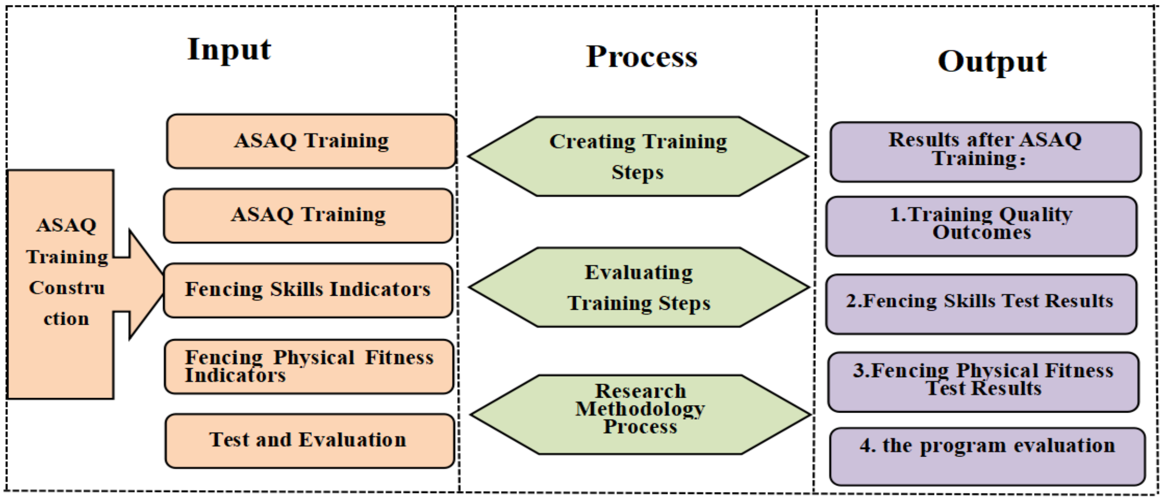

Figure 1 Conceptual Framework of Research

Methodology

Population: This study involved 62 athletes from the Guangzhou fencing team, including 35 males and 27 females. These athletes had not experienced sports injuries in the past six months and were in good physical condition.

Sample: Based on the scores from basic fencing techniques and physical fitness tests, athletes were sequentially numbered from 1 to 62 in descending order of their scores. They were then divided into two groups using systematic sampling: the experimental group (n=31) and the control group (n=31).

Research Tools: Include Expert Interviews, Questionnaires, the ASAQ Training Program Combined with the Traditional Fencing Training Program, and a Manual for Fencing Technique and Physical Fitness Testing.

Data Collection: (1) Review the literature and analyze the technical and physical training content related to fencing ASAQ. (2) Conduct expert interviews to confirm the ASAQ training program and test content (first round) and the practicality of ASAQ training (second round), The interviewees consist of 5 experts. (3) Design the fencing ASAQ training program and comprehensive technical test indicators and invite 6 experts for IOC evaluation. (4) Conduct a group test using the ASAQ training program on the experimental subjects, collect data, and revise the plan. (5) Officially start the 8-week continuous experiment, collecting training data before and after the experiment.

Data Analysis: Analyze the pre-test differences in fencing skills and physical performance indicators between the experimental and control groups using independent samples t-tests. Analyze the differences in technical indicator scores at different stages between the experimental and control groups using repeated measures ANOVA and post hoc analysis with LSD. Analyze the post-test differences in fencing skills and physical performance indicators between the experimental and control groups using independent samples t-tests.

Results

Basic Data Analysis of Experimental Subjects

Before the experiment, we tested the age, height, and weight data of 62 athletes, as well as their basic fencing skills and physical fitness. The results showed that the development levels of both groups of

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subjects were at the same baseline, with no statistically significant differences (p > 0.05), meaning that the next phase of experimental research could proceed (see Table 1).

Table 1 Basic Information for the Subjects (n= 62)

Item	Exp	Con	t	p
Age	12.97±1.82	13.90±2.12	-1.866	0.067
Height	162.05±14.89	163.15±13.29	-0.307	0.76
Weight	51.47±16.23	50.85±13.34	0.165	0.87
Lunge Thrust	16.19±2.3	16.32±2.12	-0.23	0.819
14 Meters Sword	9.56±1.49	9.82±1.69	-0.654	0.516
One-Minute Sit-ups	43.39±9.39	44.74±7.76	-0.619	0.538
One-Minute Jump	142.81±23.94	137.48±32.35	0.736	0.464
800 Meters Run	3.35±0.41	3.31±0.48	0.369	0.714
Standing Long Jump	2.08±0.28	2±0.25	1.191	0.238
Lunge Depth	0.76±0.05	0.75±0.05	0.749	0.457
Split Index	1.07±0.04	1.07±0.04	-0.367	0.715

Analysis of Experimental Results

To compare the pre-test differences in fencing skills and physical fitness indicators between the experimental group and the control group, an independent samples t-test was conducted (see Table 2). The test analysis showed that there were no significant differences in the pre-test scores of various indicators between the experimental group and the control group.

Table 2 Comparison of Fencing Skills and Physical Fitness at Pre-test Between Experimental and Control Groups With T-test (n=62)

Item	Groups	n	$\bar{X}$±SD	t	p
Lunge thrust attack	Exp	31	16.19±2.30	-0.23	0.819
	Con	31	16.32±2.12		
14-Meters Shuttle Movement	Exp	31	9.56±1.49	-0.654	0.516
	Con	31	9.82±1.69		
2-4-2 Attack and Defense Footwork	Exp	31	14.11±2.16	0.451	0.653
	Con	31	13.85±2.40		
Lunge, Attack, Defense	Exp Con	31 31	9．45±1．17 9.35±1.19	0.352	0.726
Comprehensive Technique	Exp	31	36.17±5.84	-0.227	0.821

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Item	Groups	n	X̄±SD	t	p
	Con	31	36.47±4.56		
15 Meters Obstacle Sprint	Exp Con	31 31	5.36±0.72 5.40±0.75	-0.184	0.855
Hexagon Agility	Exp Con	31 31	24.31±5.99 23.37±5.92	0.625	0.534
Meters800	Exp Con	31 30	3.35±0.41 3.31±0.48	0.369	0.714
Sit-ups in One Minute	Exp Con	31 31	43.39±9.39 44.74±7.76	-0.619	0.538
Jump Ropes in One Minute	Exp Con	31 31	142.81±23. 137.48±32.	0.736	0.464
Standing_Long_Jump	Exp Con	31 31	2.08±0.28 2.00±0.25	1.191	0.238

To compare the fencing skills in the experimental group across different stages of ASAQ training, repeated measures of ANOVA and LSD post hoc tests were conducted (see Tables 3 and 4). The results showed that the scores of the experimental group in the Lunge Thrust Attack, 14 meters Sword Shuttle Movement, 2-4-2 Attack and Defense Footwork, Lunge Attack Defense, and Comprehensive Technique indicators exhibited significant differences across different stages, with significance levels at P<0.05. The trend of score differences at these stages is illustrated in Figure 2.

Table 3 Comparison of Fencing Skill Indicators Across Four Stages within the Experimental Group Whit Repeated Measures ANOVA (n=31)

Variables	Source of variance	Sum of Squares	df	MS	F	p
Lunge Thrust Attack	Test	460.03	3	153.34	78.88	.01*
	error	174.97	90	1.94		
	Total	635	93	155.28		
14 Meters Sword Shuttle Movement	Test	26.92	3	8.97	38.35	.01*
	error	21.06	90	0.23		
	Total	47.98	93	9.2		
2-4-2 Attack and Defense Footwork	Test	194.68	3	64.89	144.03	.01*
	error	40.55	90	0.45		
	Total	235.23	93	65.34		

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Variables	Source of variance	Sum of Squares	df	MS	F	p
Lunge Attack Defense	Test	52.55	3	17.52	85.56	.01*
	error	18.42	90	0.21		
	Total	70.97	93	17.73		
Comprehensive Technique	Test	163.24	3	54.41	11.75	.01*
	error	416.93	90	4.63		
	Total	580.17	93	59.04		

*$P<.05$

Based on the post hoc analysis results in Table 4, the following conclusions can be drawn:

For the Lunge Thrust Attack indicator, the Pretest scores are significantly lower than those at After 4, After 6, and Posttest; After 4 scores are significantly lower than those at After 6 and Posttest; After 6 scores are significantly lower than those at Posttest.

For the 14 meters Sword Shuttle Movement indicator, the time taken in Pretest is significantly higher than that in After 4, After 6, and Posttest; the time taken in After 4 is significantly higher than that in After 6 and Posttest; the time taken in After 6 is significantly higher than that in Posttest.

For the 2-4-2 Attack and Defense Footwork indicator, the time taken in Pretest is significantly higher than that in After 4, After 6, and Posttest; the time taken in After 4 is significantly higher than that in After 6 and Posttest; the time taken in After 6 is significantly higher than that in Posttest.

For the Lunge Attack Defense indicator, the time taken in Pretest is significantly higher than that in After 4, After 6, and Posttest; the time taken in After 4 is significantly higher than that in After 6 and Posttest; the time taken in After 6 is significantly higher than that in Posttest.

For the Comprehensive Technique indicator, the time taken in Pretest is significantly higher than that in After 6 and Posttest; the time taken in After 4 is significantly higher than that in After 6 and Posttest.

Table 4 Examination of Score Differences in Technical Indicators Across Different Stages of ASAQ Training in the Experimental Group with LSD Post Hoc Test (n=31)

Variable	Week	Pretest	After Week 4	After Week 6	Posttest
Lunge Thrust Attack	Pretest	xxx	-1.71*	-4.07*	-4.87*
	After4		xxx	-2.36*	-3.16*
	After 6			xxx	-0.8*
	posttest				xxx
14 Meters Sword Shuttle Movement	Pretest	xxx	0.56*	1.00*	1.22*
	After4		xxx	0.44*	0.66*
	After 6			xxx	0.22*
	posttest				xxx
2-4-2 Attack and Defense Footwork	Pretest	xxx	0.69*	2.42*	3.09*
	After4		xxx	1.73*	2.40*
	After 6			xxx	0.67*

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Variable	Week	Pretest	After Week 4	After Week 6	Posttest
	posttest				xxx
Lunge Attack Defense	Pretest	xxx	0.55*	1.33*	1.66*
	After4		xxx	0.78*	1.11*
	After 6			xxx	0.33*
	posttest				xxx
Comprehensive Technique	Pretest	xxx	-0.44	1.53*	2.4*
	After4		xxx	1.97*	2.84*
	After 6			xxx	0.87
	posttest				xxx

**P<.05*

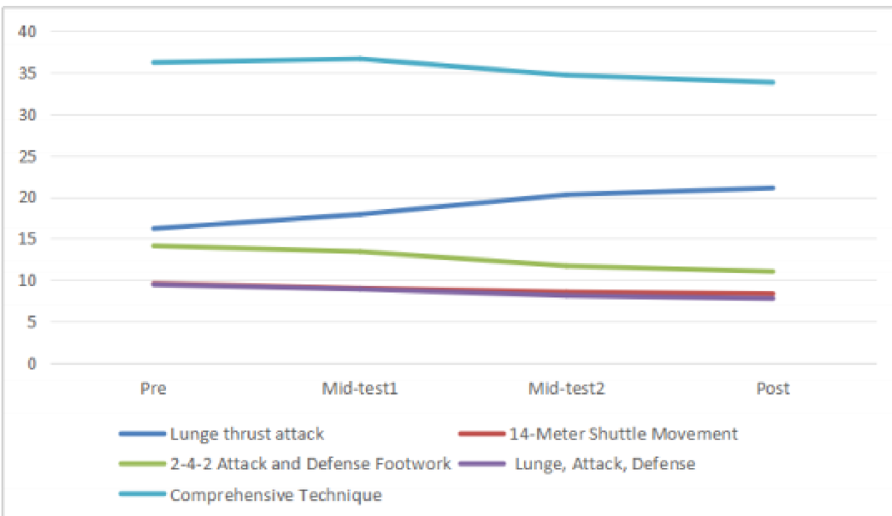

Figure 2 Trend of Score Differences at Different Stages of ASAQ Training in the Experimental Group

To compare the score differences in the control group across different stages of traditional training, repeated measures of ANOVA and LSD post hoc tests were conducted (see Tables 5 and 6). The results showed that the scores of the control group in Lunge Thrust Attack, 14 meters Sword Shuttle Movement, 2-4-2 Attack and Defense Footwork, Lunge Attack Defense, and Comprehensive Technique indicators exhibited significant differences across all stages, with significance levels at P<0.05. The trend of these score differences is illustrated in Figure 3.

Table 5 Comparison of Fencing Skill Indicators Across Four Stages in the Control Group with Repeated Measures ANOVA (n=31)

Variables	Source of variance	Sum of Squares	df	Ms	F	p
Lunge Thrust Attack	Test	33.38	3	11.13	5.60	.01*
	error	178.87	90	1.99		
	Total	212.25	93	13.12		

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Variables	Source of variance	Sum of Squares	df	Ms	F	p
14 Meters Sword Shuttle Movement	Test	3.33	3	1.11	6.74	.01*
	error	14.81	90	0.17		
	Total	18.14	93	1.28		
2-4-2 Attack and Defense Footwork	Test	22.78	3	7.59	6.76	.01*
	error	101.11	90	1.12		
	Total	123.89	93	8.71		
Lunge Attack Defense	Test	3.68	3	1.23	5.39	.01*
	error	20.50	90	0.23		
	Total	24.18	93	1.46		
Comprehensive Technique	Test	30.44	3	10.15	6.08	.01*
	error	150.22	90	1.67		
	Total	180.66	93	11.82		

$*P<.05$

Based on the post hoc analysis results in Table 6, the following conclusions can be drawn:

For the Lunge Thrust Attack indicator, the Pretest scores were significantly lower than the Posttest scores, and the After 4 scores were significantly lower than the Posttest scores.

For the 14-meter Sword Shuttle Movement indicator, the time taken in the Pretest was significantly higher than that in After 6 and the Posttest and the time taken in After 4 was significantly higher than that in the Posttest.

For the 2-4-2 Attack and Defense Footwork indicator, the time taken in Pretest was significantly higher than that in After 6 and Posttest, and the time taken in After 4 was significantly higher than that in After 6 and Posttest.

For the Lunge Attack Defense indicator, the time taken in the Pretest was significantly higher than that in After 4, After 6, and Posttest.

For the Comprehensive Technique indicator, the time taken in the Pretest was significantly lower than that in After 4, the time taken in After 4 was significantly higher than that in the Posttest, and the time taken in After 6 was significantly higher than that in the Posttest.

Table 6 Examination of Score Differences in Technical Indicators Across Different Stages of Traditional Training in the Control Group with LSD Post Hoc Test (n=31)

Variable	Week	Pretest	After Week 4	After Week 6	Posttest
Lunge Thrust Attack	Pretest	xxx	0.06	-0.55	-1.23*
	After4		xxx	-0.61	-1.29*
	After 6			xxx	-0.68
	posttest				xxx
14 Meters Sword Shuttle Movement	Pretest	xxx	0.21	0.31*	0.45*
	After4		xxx	0.1	0.24*
	After 6			xxx	0.14

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Variable	Week	Pretest	After Week 4	After Week 6	Posttest
	posttest				xxx
2-4-2 Attack and Defense Footwork	Pretest	xxx	0.24	1.02*	0.89*
	After4		xxx	0.78*	0.65*
	After 6			xxx	-0.13
	posttest				xxx
Lunge Attack Defense	Pretest	xxx	0.32*	0.31*	0.48*
	After4		xxx	-0.01	0.16
	After 6			xxx	0.17
	posttest				xxx
Comprehensive Technique	Pretest	xxx	-0.93*	-0.57	0.35
	After4		xxx	0.36	1.28*
	After 6			xxx	0.92*
	posttest				xxx

**P<.05*

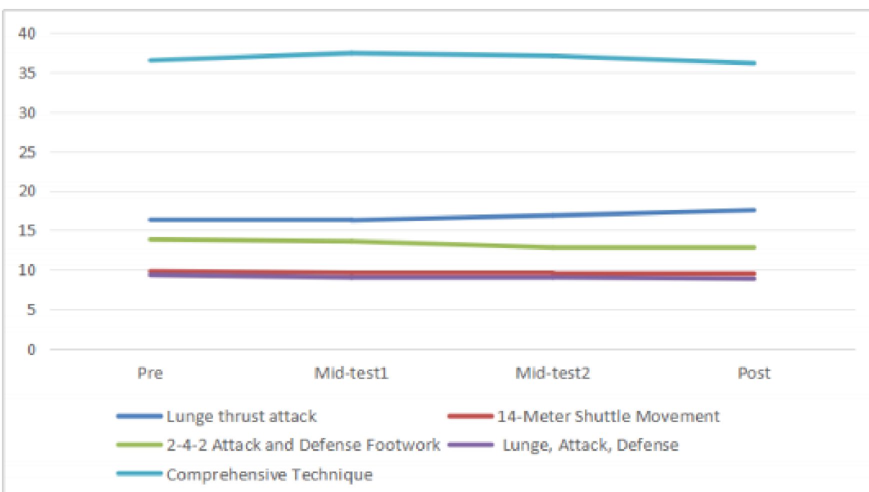

Figure 3 Trend of Score Differences at Different Stages of Traditional Training in the Control Group

To compare the differences in fencing technique indicators between the experimental and control groups in the post-test, an independent samples t-test was conducted（see Table 7）. The results of the test are shown as follows:

Lunge thrust attack scores showed significant differences between the experimental group and the control group, with t=4.625, P<0.05, indicating that the experimental group scored significantly higher.

14-meter shuttle movement scores showed significant differences between the experimental group and the control group, with t=-3.254, P<0.05, indicating that the experimental group scored significantly lower.

2-4-2 attack and defense footwork scores showed significant differences between the experimental group and the control group, with t=-3.668, P<0.05, indicating that the experimental group scored

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significantly lower.

Lunge, attack, and defense scores showed significant differences between the experimental group and the control group, with t= - 4.108, P<0.05, indicating that the experimental group scored significantly lower.

Comprehensive technique scores did not show significant differences between the experimental group and the control group was not different.

Table 7 Comparison of Post-test of fencing Skill Indicators by Independent Samples t-test Between the Experimental Group and Control Group (n=62)

Item	group	n	$\bar{X}$±SD	t	P
Lunge thrust attack	Exp	31	21.06±2.80	4.625	<0.001*
	Con	31	17.55±3.17		
14-Meters Shuttle Movement	Exp	31	8.34±1.00	-3.254	0.002*
	Con	31	9.37±1.46		
2-4-2 Attack and Defense Footwork	Exp	31	11.02±1.95	-3.668	0.001*
	Con	31	12.96±2.22		
Lunge, Attack, Defense	Exp	31	7.79±0.90	-4.108	<0.001*
	Con	31	8.87±1.15		
Comprehensive Technique	Exp	31	33.77±6.10	-1.773	0.082
	Con	31	36.12±4.17		

**P*<.05

To compare the post-test differences in physical fitness indicators between the experimental and control groups, an independent samples t-test was conducted (see Table 8). The results of the test are shown as follows:

The 15-meter run obstacle sprint scores showed significant differences between the experimental group and the control group, with t=-4.885, P<0.05, indicating that the experimental group scored significantly lower than the control group.

Jump ropes in one minute, the scores showed significant differences between the experimental group and the control group, with t=2.972, P<0.05, indicating that the experimental group scored significantly higher than the control group.

Standing long jump scores showed significant differences between the experimental group and the control group, with t=2.383, P<0.05, indicating that the experimental group scored significantly higher than the control group.

Hexagon agility, 800-meter run, and sit-ups in one-minute scores did not show significant differences between the experimental group and the control group.

Table 8 Comparison of Post-test Physical Fitness Indicators Between the Experimental and Control Groups with Independent Samples T-test

Item	group	n	$\bar{X}$±SD	t	P
15Meters Obstacle Sprin	Exp	31	4.38±0.54	-4.885	0.01*

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Item	group	n	$\bar{X}$±SD	t	P
	Con	31	5.15±0.69		
Hexagon_Agility	Exp	31	18.82±2.59	-1.921	0.06
	Con	31	20.55±4.29		
Meters800	Exp	31	2.97±0.36	-1.713	0.09
	Con	31	3.15±0.45		
Sit-ups in One Minute	Exp	31	46.87±7.99	1.035	0.30
	Con	31	44.81±7.72		
Jump Ropes in One Minute	Exp	31	161.03±25.48	2.972	0.01*
	Con	31	140.10±29.82		
Standing_Long_Jump	Exp	31	2.22±0.32	2.383	0.02*
	Con	31	2.05±0.27		

P<.05

Analysis of Expert Interview Results on the Practicality of the ASAQ Training Program

This phase aimed to evaluate the practicality of the ASAQ training program through expert interviews. The interviewees were five experts with extensive training and teaching experience and authoritative backgrounds in the industry. Combining experimental evaluation results and related content, we conducted a comprehensive analysis of the practicality of the ASAQ training program. The analysis allowed for the conclusion that there were five interview questions.

Based on the analysis of the experts' responses to the interview questions, it was found that the experts unanimously agreed that the ASAQ training method effectively integrates technical and physical training, indicating that the ASAQ training method could improve the performance of young fencing athletes. Several experts pointed out that, compared to traditional training methods, ASAQ training avoided the monotony and mechanical repetition of exercises and could comprehensively improve athletes' accuracy, speed, agility, quick reactions, balance, and coordination. They also noted that, particularly for young athletes, ASAQ training offered greater variety and enjoyment, making it highly commendable. However, some experts emphasized that while the advantages of the ASAQ training method were acknowledged, the irreplaceable value of traditional training methods should also be considered. The experts unanimously believed that the diversity and comprehensive effectiveness of ASAQ training could help prevent injuries caused by the limitations of single-method training. Therefore, ASAQ training positively impacted the long-term development of athletes, contributing to the improvement of their overall physical fitness and competitive level.

Additionally, the experts agreed that adjusting training plans based on athletes' different levels and abilities was crucial, including adjustments to training content, intensity, and load. By implementing individualized training plans, athletes' overall performance could be maximized. Furthermore, the experts unanimously believed that establishing a training feedback mechanism was an essential aspect of enhancing training effectiveness, as it could help coaches promptly understand the athletes' training conditions and outcomes, thereby providing insight into the athletes' real training situations and allowing for timely adjustments to the training plans.

Discussion

This study showed that the ASAQ training could improve the accuracy of target-hitting techniques,

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footwork speed, and quick reactions during lunging, attacking, and defending for fencers. Although traditional training remained effective, the ASAQ training showed more significant effects, particularly in the post-training phase, where it outperformed the control group. However, the scores were significantly lower in the comprehensive technique and Test 2 phases than in Test 1 and the pre-test phase. This indicated that although there were fluctuations in the mid-term with increased training duration, the overall comprehensive technique performance significantly improved after training, with less time required. Simultaneously, ASAQ demonstrated significant effects on 15-meter obstacle sprint, one-minute jump rope, and standing long jump indicators, indicating that ASAQ can significantly improve athletes' speed, agility, coordination, balance, quick reactions, and lower limb explosive strength. This study's results met the initial research objectives and hypotheses. The developed ASAQ training program significantly improves athletes' overall performance and receives high recognition in practical applications.

These findings are consistent with those of other researchers. Mohamed conducted a study on the impact of SAQ training on saber fencers, which showed significant improvements in speed, agility, and lower limb explosive strength, further emphasizing the effectiveness of SAQ training in enhancing key performance capabilities for fencers (Mohamed & Larson, 2018).

In line with the results of this study, research by Wahhab and Viktorov found that the stronger the speed and reaction abilities of athletes, the higher their accuracy in lunging. They suggested a specific training plan focusing on lunging accuracy could significantly improve fencers' accuracy. As Abdel Khaleq (1992) stated, neuromuscular coordination, balance, and quick kinetic responses are crucial in fencing, influencing the connection between accurate performance and athletic reactions. Fencing, a sport with complex technical movements, requires the development of neuromuscular coordination and reaction speed in training. Therefore, ASAQ training applied the principles of SAQ neural system training, significantly enhancing athletes' coordination between neural and muscular movements through orderly training of neural system motor tasks. Surawan et al. (2022) similarly believed that SAQ improves athletic performance by enhancing the coordination ability reflected in the accurate cooperation between the central nervous system and muscles. These studies further support the deep-seated principles behind ASAQ training in improving athletes' skills and physical performance, emphasizing that targeted and varied practice in training helps improve athletes' overall performance and competitiveness.

These studies further confirmed the positive impact of ASAQ training on accuracy, speed, agility, and quick reactions, which can further improve fencers' performance. The results of ASAQ training revealed its underlying principles: diverse practices, such as quick footwork and agility drills, can significantly improve muscle stretch and contraction capabilities, enhancing neuromuscular efficiency and shortening reaction times. Amr et al. (2017) corroborated this view, finding that the muscles' stretch-shortening cycle could reduce the gap between traditional resistance and specific motion training.

However, although the experimental group scored higher on comprehensive technical indicators than the control group, the effect could have been more pronounced. This might have been due to insufficient training duration or intensity. Future research could consider extending the training duration and increasing the training intensity to explore the effects further. Additionally, we found no significant differences between the experimental and control groups in metrics such as the 800-meter run and one-minute sit-ups, which indicated that SAQ training did not significantly affect cardiovascular endurance and abdominal strength. However, some studies held different views. For example, the research by Dhapola (2017) and Arivazhagan (2022) suggested that SAQ training could improve athletes' cardiovascular endurance and resting pulse rate, implying that the high-intensity, short-interval nature of SAQ training could promote cardiovascular endurance. Our study's lack of significant results might have been due to the shorter training duration or insufficient intensity. Future studies might consider extending the training period or increasing the intensity to verify its effects. Therefore, this also indicated that traditional training methods remained irreplaceable in training cardiovascular endurance and abdominal strength.

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Recommendation

Based on expert advice, we propose the following three recommendations:

1. Before starting training, coaches should implement the training after mastering the principles, methods, and guidelines of ASAQ, set phased goals, and make personalized adjustments while scientifically adjusting the intensity to prevent overtraining and related injuries.

2. The ASAQ training program is suitable for fencers, beginners, and enthusiasts and is recommended for promotion in universities, sports schools, and clubs. Enhancing coach training to develop athletes' and students' comprehensive abilities is advisable.

3. Recommendations for future research directions:

1) Future studies could expand the sample range to include different regions and ages to enhance the representativeness of the results.

2) Future research could examine the characteristics of different types of fencing and study the impact of the ASAQ program on offense, defense, and tactics.

3) Future studies could integrate objective data such as physiological and biochemical indicators and athletic performance, utilizing scientific tools and equipment like GPS sports tracking systems and other wearable devices for training monitoring to enhance the accuracy of the results.

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