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The Impact of Synchronized Swimming Water Sensation Exercises on the Athletic Performance and Stroking Effect of College-Level Specialized Swimming Athletes

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Abstract: *As swimming training methods diversify, the interconnectivity among aquatic sports has increasingly caught the attention of coaches and athletes. Today, water sensation exercises have attracted some coaches and athletes in the swimming field who believe that these exercises can help improve athletic performance. Synchronized swimming, often referred to as "ballet in water", requires a high level of water sensation. This paper introduces water sensation training methods from synchronized swimming into swimming training, employing literature review, experimental method, comparative analysis, and interview method for research. By utilizing various water sensation exercises, this study aims to enhance athletes' water sensitivity and adaptability as well as the ability to grab and stick to the water during each stroke, thereby improving their performance and stroking effect.*

Keywords: *Water Sensation, Synchronized Swimming, Athletic Performance*

1. Introduction

1.1. Research Background

With the continuous development of modern swimming techniques, the study of water sensation training is increasingly gaining attention. Water sensation, a specialized sensory perception in swimming [1], is a crucial factor affecting the performance of swimmers [2]. Therefore, how to effectively use water sensation exercises to enhance performance has become an important research issue for coaches. As a branch of aquatic sports, synchronized swimming demands a high level of water sensation [3]. All supporting actions are completed by hands paddling the water, which requires athletes to undergo long-term repetitive training of hand shape and position changes to master these skills and maximize stroking, thereby applying them in practice. For swimming sports, it is hoped that through synchronized swimming water sensation exercises, athletes can better familiarize themselves with water, improve their ability to sense water, and integrate movement techniques, thereby enhancing competitive ability and achieving improved athletic performance.

1.2. Research Objectives

The purpose of this study is to incorporate water sensation training methods from synchronized swimming into swimming training and combine them with swimming technique exercises, expecting that through periodic training, athletes' performance and stroke efficiency will be significantly improved.

1.3. Research Subjects

Twenty students from the 2021 class of the School of Sports Training at Wuhan Sports University specializing in swimming were selected for this study [4]. Ten students were placed in the experimental group and ten in the control group, ensuring no significant differences in basic swimming level or physical fitness between the groups before the experiment. The teaching non-experimental factors were basically the same, the grouping was reasonable, and there were no obvious differences in each indicator, which basically met the requirements of the experiment.

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2. Improving Athletes' Performance and Stroke Effect through Synchronized Swimming Water Sensation Practice

2.1. Methods of Synchronized Swimming Water Sensation Practice

The Through understanding the synchronized swimming water sensation exercises, applicable training methods are borrowed and adapted according to the specific conditions of the specialized class students, appropriately reducing the difficulty level to ensure that students can complete the training as required [5]. Part of the exercises that can be applied are shown in Table 1.

Table 1: Synchronized Swimming Water Sensation Training Methods

Movement Name	Body Position	Arm Position	Hand/Palm Formation	Movement Direction	Number of Repetitions
Torpedo	Lying back on the surface	Arms straight at sides, around hip level	Wrist pressed down, fingertips pointing down	Moving feet forward	2 repetitions: 4x50m
Back float (head-first)	Lying back on the surface	Arms straight at sides, around hip level	Wrist pressed down, fingertips slightly upturned	Moving head forward	2 repetitions: 2x50m
Back float (feet-first)	Lying back on the surface	Arms straight above the head	Wrist curled, fingertips slightly upturned	Moving feet forward	2 repetitions: 2x50m
Front float (head-first)	Lying face down on the surface	Arms straight at sides, around hip level	Palms facing backwards at a 45° angle, stroking outwards and inwards	Moving head forward	2 repetitions: 2x50m
Front float (feet-first)	Lying face down on the surface	Arms straight above the head	Wrist pressed down, fingertips slightly upturned	Moving feet forward	2 repetitions: 2x50m

2.2. Considerations When Integrating Synchronized Swimming Water Sensation Practice into Swimming Training

Due to the difficulty of the movements in synchronized swimming water sensation exercises [6], it is important to control the distance of each swim (starting from 25 meters and transitioning to 50 meters) and set a reasonable number of training repetitions (2-4 repetitions per movement are advisable). The water sensation exercises are interspersed between warm-up activities and intensive training, focusing on helping athletes feel water, grasp water, and experience water resistance. While performing water sensation exercises, athletes should maintain a relaxed, horizontal body position and seriously experience the feeling of grasping the water (if legs sink, floating boards may be clamped between the thighs to assist). Finally, attention should be paid to the related technical movements during practice to avoid superfluous actions or mistakes that lead to poor exercise effects.

2.3. Implementing Specific Plans for Incorporating Synchronized Swimming Water Sensation Exercises into Training for University-Level Specialized Class Swimmers

Water sensation training is divided into two parts: foundational training and specialized training. Foundational training includes five types of water sensation exercises from synchronized swimming, while specialized training involves water sensation exercises selected according to the individual conditions of the athletes [7]. An example of a water sensation plan usable by athletes is shown in Table 2.

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Table 2: Water Sensation Plan for Athletes

Movement Name	Number of Repetitions
Torpedo	2x50m
Front float (head-first)	2x50m
Back float (head-first)	2x50m
Front float (feet-first)	2x50m

3. Research Methods

3.1. Research Methods

3.1.1. Literature Review Method

By reviewing and collecting relevant materials on synchronized swimming water sensation training, this study keeps abreast of the latest academic developments in the field of "water sensation" in synchronized swimming, understands the current mainstream water sensation training methods, and makes specialized adjustments to synchronized swimming water sensation training, thus laying a solid foundation for the conduct of practical research.

3.1.2. Experimental Method

3.1.2.1. Experimental Design

Based on an analysis of current synchronized swimming water sensation training methods, it is evident that to better apply these in swimming, certain training details need to be improved and analyzed to develop methods applicable to swimming. This experiment mainly divides participants into an experimental group and a control group, where the experimental group undertakes enhanced water sensation training, and the control group continues with regular training. Performance comparisons between the two groups are then analyzed after the training.

3.1.2.2. Equipment

The study will employ a 4K high-definition underwater action camera to record the 50-meter freestyle and 50-meter breaststroke stroke frequency and swim times for all participants before and after the training sessions.

3.1.3. Comparative Analysis Method

During the training process, the main comparisons and analyses are conducted through three aspects: first, by comparing the specific scores obtained before and after the experiment to evaluate the impact of water sensation training on performance; second, by observing stroke amplitude and frequency to assess their impact on swimming; third, by comparing the athletes' proprioceptive changes before and after training to collect survey data and draw conclusions and suggestions.

3.1.4. Interview Method

According to the research content and objectives, and following the basic principles of interviewing, an outline of questions is designed for the swimmers in the experimental group. Reasonable inquiries are made, attention is paid to recording and collecting information, and a detailed analysis is conducted accordingly.

3.2. Research Design Plan

X number of specialized class students will be randomly divided into two groups: Group A (experimental group) and Group B (control group). Results will be recorded using Excel or a similar spreadsheet application. Group A will engage in 30 minutes of modified water sensation practice before each formal training session, as described in aforementioned Table 1. Researchers should control the training load at 40%-50% of maximum heart rate. Group B will undergo conventional training to ensure equal training volume between the two groups, with the experimental period lasting 10 weeks. Performance indicators before and after the experiment will use the results of 50-meter freestyle and 50-meter breaststroke times and swim efficiency index 【Swim Efficiency Index = (Swim Distance - Height)2 / (Number of Strokes * Swim Time)】[8] as the basis for data analysis. Height, number of strokes, and swim distance will be uniformly measured before the experiment; after the experiment, the number

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of strokes and swim distance will be measured again (measurement method: start from the wall push in the water, measuring the number of strokes and time for 50m). Researchers must monitor the experiment process closely. After the experiment ends, collect and analyze the test data to draw conclusions.

4. Results and Discussion

4.1. Comparison of Athletic Performance Before and After the Experiment

After ten weeks of systematic training, both the experimental and control groups showed improvement in their athletic performance, though with some differences in the extent of improvement. A case analysis of one person from each group shows that in the 50-meter freestyle, the athlete from the experimental group improved their time from 27.3 seconds to 26.6 seconds, shortening their swim time by 0.7 seconds; the control group's athlete improved from 27.7 seconds to 27.4 seconds, shortening their swim time by 0.3 seconds. In the 50-meter breaststroke, the experimental group's athlete improved their time from 35.6 seconds to 34.4 seconds, shortening their swim time by 1.2 seconds; the control group's athlete improved from 36.1 seconds to 35.2 seconds, shortening their swim time by 0.9 seconds. Comparing the two groups, it is evident that the athletes from the experimental group showed a greater increase in athletic performance and faster improvement. Specific experimental data are shown in Table 3.

Table 3: Comparison of Athletic Performance Between Experimental and Control Groups

Group	50m Freestyle Before (s)	50m Freestyle After (s)	Time Reduction (s)	Increase (%)
Experimental Group	27.3	26.6	0.7	-2.56%
Control Group	27.7	27.4	0.3	-1.08%

Group	50m Breaststroke Before (s)	50m Breaststroke After (s)	Time Reduction (s)	Increase (%)
Experimental Group	35.6	34.4	1.2	-3.37%
Control Group	36.1	35.2	0.9	-2.49%

From the data above, it can be observed that after a period of basic and specialized water sensation training, athletes showed a slightly greater improvement in their performance in 50-meter freestyle and 50-meter breaststroke compared to those who did not undergo water sensation training. Thus, it can be seen that integrating water sensation exercises from synchronized swimming into swimming training has a certain effect on enhancing athletes' performance [9].

4.2. Comparison of Stroke Counts Before and After the Experiment

After 10 weeks of systematic training, both the experimental group and the control group showed a reduction in the number of strokes during the 50-meter freestyle and 50-meter breaststroke. A case analysis of one individual from each group shows that in the 50-meter freestyle, the experimental group's stroke count reduced from 40 to 36 strokes, and in the 50-meter breaststroke, from 20 to 17 strokes; the control group's stroke count in the 50-meter freestyle reduced from 42 to 41 strokes, and in the 50-meter breaststroke from 22 to 20 strokes. Comparing the two groups, it is evident that the athletes in the experimental group experienced a greater reduction in stroke count before and after the experiment, thus achieving a faster improvement in swimming efficiency. Specific experimental data are shown in Table 4.

Table 4: Comparison of Stroke Counts Between Experimental and Control Groups

Group	Pre-experiment 50m Freestyle Stroke Count	Post-experiment 50m Freestyle Stroke Count	Pre-experiment 50m Breaststroke Stroke Count	Post-experiment 50m Breaststroke Stroke Count
Experimental Group	40 strokes	36 strokes	20 strokes	17 strokes
Control Group	42 strokes	41 strokes	22 strokes	20 strokes

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From the data above, it can be seen that incorporating synchronized swimming water sensation exercises into swimming training can to some extent help athletes reduce the number of strokes and increase stroking efficiency [10] , thus achieving greater training benefits within the same period of time.

4.3. Changes in Swimming Efficiency Index Before and After the Experiment

Based on the formula for the swimming efficiency index 【Swimming Efficiency Index = (Swim Distance - Height)² / (Number of Strokes * Swim Time)】, the calculated indices are as follows:

Table 5: Comparison of Swimming Efficiency Index Between Experimental and Control Groups

50-meter Freestyle

Group	Pre-Experiment Efficiency Index	Post-Experiment Efficiency Index	Increase in Efficiency Index
Experimental Group	1.63	1.95	0.32
Control Group	1.60	1.62	0.02

50-meter Breaststroke

Group	Pre-Experiment Efficiency Index	Post-Experiment Efficiency Index	Increase in Efficiency Index
Experimental Group	2.62	3.19	0.57
Control Group	2.35	2.65	0.30

The data above shows that, after a period of basic specialized water sensation training, both the experimental and control groups exhibited growth in their swimming efficiency index for both 50-meter freestyle and 50-meter breaststroke. Compared to the control group, the experimental group showed a greater increase in efficiency indices, from 1.63 to 1.95 in the 50-meter freestyle and from 2.62 to 3.19 in the 50-meter breaststroke; the control group showed an increase from 1.60 to 1.62 in freestyle and from 2.35 to 2.65 in breaststroke. Comparing the two groups, it is evident that the athletes in the experimental group had a greater increase in swimming efficiency index before and after the experiment, and their swimming efficiency improved faster than those in the control group. The specific experimental data is shown in Table 5.

4.4. Athletes' Perceptions of Stroking Effect Before and After the Experiment

Interviews with athletes revealed that after a period of synchronized swimming water sensation training, most athletes felt a stronger flow of water on their palms and arms, a more solid and stable grip on the water, and a stronger sensation of pushing the water backward. They noted a clearer perception of changes in the water flow compared to before, and during stroking, there was a feeling of having a fulcrum which allowed better control over the muscles used for propulsion, and a noticeable improvement in stroking efficiency. Athletes reported that during full-effort swimming, their stroking efficiency was higher than before, with a more solid and stable feeling during water grip and push, and without incidents of missing the water or breaking through the water.

4.5. Changes in Athletes' Affection for Training Before and After the Experiment

After incorporating basic and specialized water sensation training into their regimen, most athletes developed a significant interest in water sensation exercises. They found the synchronized swimming water sensation training novel and believed it was not only a method to learn new training techniques but also a way to improve performance and focus during training. The diversified water sensation exercises quickly established a refined sense of the water flow, allowing athletes to have a deeper understanding of swimming, improve their swimming efficiency, and to some extent, also enhanced their confidence and enthusiasm for training.

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5. Conclusion and Recommendations

5.1. Conclusion

1) Synchronized swimming water sensation exercises have a positive effect on improving the performance in 50-meter breaststroke and 50-meter freestyle for the students of the 2021 class at the School of Sports Training specializing in swimming. Through experimental methods and comparative analysis, integrating basic water sensation exercises and specialized water sensation exercises into swimming training and conducting 10 weeks of systematic training, it is observed that the performance improvement in the experimental group is slightly greater than in the control group [11]. Thus, it is evident that incorporating water sensation exercises from synchronized swimming into swimming training can aid in enhancing athletic performance.

2) Synchronized swimming water sensation training helps to enhance stroke efficiency in swimmers. After 10 weeks of water sensation training, athletes can more profoundly sense the subtle changes in water flow on their arms, thus better utilizing the reactive force of the water to improve stroke efficiency and enhance stroking effectiveness. Comparisons of the number of strokes before and after the experiment show that the experimental group, after water sensation practice, reduced their stroke count in both swimming styles more than the control group; comparisons of swimming efficiency indices show that the increase in the experimental group is greater than in the control group, thus indicating a faster improvement in efficiency. Therefore, it is clear that water sensation exercises from synchronized swimming have a certain effect on improving stroke efficiency.

3) Synchronized swimming water sensation training can enhance athletes' focus during training to some extent, adjust their mindset, deepen their understanding of swimming, and reduce the occurrence of negative emotions such as training fatigue and passivity. Detailed interviews conducted after the experiment and the recording of athletes' responses show that synchronized swimming water sensation exercises positively impact athletes' training focus, training mindset, and psychological aspects.

5.2. Recommendations

1) Basic synchronized swimming water sensation exercises can be incorporated into swimming training along with specialized water sensation exercises selected based on individual conditions, to help athletes improve their water perception abilities and thereby enhance athletic performance.

2) Given the current interim research results, authors of this paper believe that further in-depth research can be conducted. Once significant results are achieved, it is possible to promote the widespread adoption of synchronized swimming water sensation exercises in the sport of swimming, expecting them to play a role during the athlete selection period, pre-adolescent developmental phase, and competitive performance enhancement stage. This could provide practical methods to advance the progress of China's swimming endeavors.

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