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The Effect of the Combined Training on the Freestyle Flip Turn

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ABSTRACT

The objective of the present research was to compare the effect of the sequence of concurrent strength and endurance exercises on the freestyle tumble turn. Forty male subjects between the ages of 15 and 19 years, with at least two years of competitive swimming experience, volunteered to participate in the study. The average age of 17.22 ± 0.94 years, 169.62 ± 7.11 Cm of height, and 62.82 ± 7.78 Kg of body mass were randomly chosen and divided into five groups of eight subjects – i.e. strength training (ST), endurance training (ET), strength-endurance training (SE), endurance-strength training (ES) and control (CO). The analyzed variables were the time duration, in seconds, of each turn phase: rolling time (RT), wall contact time (WCT), pushing time (PT), gliding time (GD) and 5 m round trip time (5mRTT) were calculated for each subject. There was the significant of the strength training on the 5mRRT and WCT. There were no significant changes in other training on the each turn phase.

Key words: strength training, endurance training, concurrent training, tumble turn.

INTRODUCTION

Training is a process in which sports activities and exercises are performed regularly, gradually and progressively and it increases the ability of individuals in achieving a better performance [4]. Training adjustment depends on the type of the chosen training program, that is, strength training program has the greatest effect on strength and endurance training program has the greatest effect on cardiovascular system. Therefore each of the strength and endurance training programs results in its own specific adjustment [6]. Endurance exercises increase VO_2max; increase the number of mitochondria and their specific enzymes [9]. Endurance exercises lead to a significant increase in type I muscle fibers, since these fibers have a large amount of mitochondria [3]. As a result of endurance exercises, muscle mass does not increase and the actual size of muscle fibers decreases. Strength exercises lead to muscle hypertrophy due to the increase in the number of fibril proteins. Muscle hypertrophy usually occurs in slow-twitch and fast-twitch fibers and this type of training results in a special neuromuscular adjustment. Unlike endurance exercises, mass density of mitochondria decreases in contrast to the increase in muscle mass [1]. These contradictory results of endurance and strength exercises has led to uncertainties among some endurance and strength athletes in applying different training methods, fearing it might risk the desired training adjustments [8]. In any case, certain levels of strength and endurance are of interest for any athlete. Some sports are mainly strength-oriented and some others are mainly endurance-oriented, while most sports need a combination of both. Research studies have shown that performing strength and endurance exercises simultaneously and concurrently has a greater effect on athletes' performance in

comparison with performing each of these exercises alone [2]. On the other hand, with turn times accounting for up to one third of the total race time, minor improvements in turning performance can lead to substantially improved event times. A successful swim turn results from a multitude of factors and requires a complex series of maneuvers to optimize the total turning performance. Unfortunately dry-land exercises and weight-training programs in the sport of swimming frequently focus their attention on the development of upper body strength. In accordance with the concept of specificity, much time and effort has been spent on the development of specific exercises or weight training procedures that closely mimic swimming movements. Because of this it has been suggested that swimmers, in general, lack the dynamic lower body strength needed to maximize performance in the turns. This may also be because the benefits of developing explosive Sequence of Concurrent Strength and Endurance Training have not been properly investigated [9].

MATERIALS AND METHODS

Forty male with the average age of 17.22±0.94 years, 175.62±7.11 centimeters of height, and 62.82±7.78 kilograms of body mass were randomly chosen and divided into five groups of eight subjects – i.e. strength training (ST), endurance training (ET), strength-endurance training (SE), endurance-strength training (ES) and control (CO), the swimmers had at least two years of competitive swimming experience and importantly, they were competent and well practiced in the freestyle flip turn technique. After a briefing session and becoming familiar with the equipment, subjects took the preliminary pretest. Then the designed training program of each group was conducted for eight weeks. Each session involved three levels:

1. Warming up (10 minutes)
2. Main training
3. Cooling down (10 minutes)

The first and the third stages (warming up and cooling down) was the same in the strength, endurance, endurance-strength and strength-endurance training groups and the difference of exercises was in the main training stage. The main training stage was designed in a way as to be similar in all the four groups as much as possible with respect to intensity and duration.

Training Program

The strength training program was of circular strength training type and in each session the subjects of this group performed exercises including foot press with foot press machine, squat, half squats, and sit-ups. In this exercise program, a 60-90 second rest was considered between each station and a 2-3 minute rest between each round. The training program of the strength training group was conducted with the following conditions: it started with 2 rounds, 10 repetitions and 50% of 1RM and finished at the end of eighth week with 2 rounds, 6 repetitions and 80% of 1RM.

The endurance training too included running, since we can control factors such as intensity, speed, distance and duration and the other reason for choosing runs as main exercise in the training program was its being undemanding and involving less injuries. The intensity of training was controlled by a pulse rate watch; an individual whose aerobic capacity was close to the group-averaged aerobic capacity wore the watch and the transmitter was worn as a belt around the sternum area which started working after a few minutes of its attachment to the chest. The endurance training program was conducted with the following conditions: it began with running for 16 minutes with 65% of maximum heart rate which increased to 30 minutes with 80% of maximum heart rate at the end of the eighth week.

The training program for the strength-endurance and endurance-strength training groups was similar; but, the strength-endurance training group first performed the strength exercises in each session and then the endurance exercises, while the endurance-strength group performed the opposite. The strength and endurance training program considered for the strength-endurance and endurance-strength groups was the same as the program of strength and endurance groups. That is, the strength-endurance group first performed the exercises of the strength training group and at the end of these exercise performed exactly the exercise protocol of the endurance training group, while the endurance-strength group did the

opposite. After performing the exercises and at the end of the eighth week, subjects took the final test. The control group did not perform any specific exercise and only control group which swam 1.5 hours, three times per week for 8 weeks. Freestyle turning performance was measured by 5m round trip time (RTT), rolling time (RT), wall contact time (WCT), pushing time (PT) gliding time (GD) and 50 yard freestyle time (50FR).

Table1: Strength and Endurance Training Program

Training Program	Strength			Endurance	
Week	**Round**	**Repetition**	**1RM**	**Running Time**	**VO_2 max**
1	2	10	50 %	16	65 %
2	2	10	60 %	18	65 %
3	3	10	65 %	20	70 %
4	2	10	65 %	22	70 %
5	3	8	70 %	24	75 %
6	3	8	75 %	26	75 %
7	3	6	80 %	28	80 %
8	2	6	80 %	30	80 %

High-Speed Video Analysis

Each swimmer performed three times turning techniques at maximum speed. Performance was videotaped using four underwater and two surface fixed cameras (JVC, 50 Hz). The trials started and finished from a specific and marked spot (at 12.5 m from the turning wall). The analyses comprised four intermediate phases of a flip turn: (1) rolling, which starts on the last frame before hand's entry in the last swimming stroke before turning and ends on the last frame before the first touch in the wall; (2) wall contact, which starts on the frame that corresponds to the first wall contact and ends on the last frame before the swimmer starts to extend the knees in order to project the body away from the wall; (3) pushing, which starts in the frame that corresponds to the first knee extension and ends on the frame that corresponds to the last wall contact; and (4) gliding, which starts on the first frame after the swimmer completely leaves the wall and ends on the frame that corresponds to the wider stage of the first leg kick out of the wall. The analyzed variables were the time duration, in seconds, of each turn phase: rolling time (RT), wall contact time (WCT), pushing time (PT) and gliding time (GD) was calculated for each subject. In order to obtain these variables, the video images were digitized using the APAS system (Ariel Dynamics, USA). The frames of interest for each phase were selected and then the time was calculated based on the sampling frequency of the video cameras. It was considered an error of 0.02 s (which corresponds to 1 video field) when determining the beginning and the end of each phase.

Statistical Method

In descriptive statistics, we described data using indices such as mean, standard deviation, and maximum and minimum number. In inferential statistics, t-test for correlated samples was used to compare differences within group and one-way ANOVA and Scheffe post-hoc test were used to compare differences between groups ($P \leq 0.05$).

RESULTS AND DISCUSSION

Results of both pre and post test of 5m round trip time (5mRTT), rolling time (RT), wall contact time (WCT), pushing time (PT), gliding time (GD) and 50m freestyle time (50FR) are presented. The finding of the research shows that there was significant difference in 5mRRT between groups. This significant decrease shows that the strength training helped to reduce the turn time. There were no significant changes in (RT), (PT), (GD) and (50FR) for pre and post in all groups. The results of the present research indicate that the strength demonstrated a significant increase in WCT, and analysis between the groups revealed that the difference between the strength and endurance-strength groups and the control group was significant. The findings of the present study showed that swimmers with strength training reduced the tumble turn time. It presented strength training can produce the high force. Moreover, there were no statistical significant differences between 5mRRT and other groups in this study. Concerning the wall connect time (WCT) phase, it showed that the strength training can increase the (WCT). The wall contact phase is initiated by feet contact with the pool wall and is finished at toe-off. The swimmer's feet should hit the wall at a depth of approximately 0.3 to 0.4 m [2]. The degree of

hip and knee flexion at wall impact varies between swimmers. Blanksby found that the tuck index (the ratio of the smallest hip-to-wall distance to total leg length) was negatively correlated with turn times. This suggests that the larger the tuck index (i.e. the straighter the legs), the faster the turn times will be [11]. Ideally the angle of the knee should be in the region of 110 - 120. A reduction in the angle of flexion at the knee (past 90) places the quadriceps muscle group (the prime muscle group in the wall push-off) at an inefficient muscle length and this in turn inhibits their ability to produce force quickly. Another advantage of a greater knee angle (i.e. less flexion) is that the swimmer has to swim less distance before turning and this can result in significant savings on time and energy over multiple turns. Flexing the knees to any great degree after contact will result in a dissipation of any stored elastic energy and an increase in the passive wall contact phase, both of which should be discouraged. On the other hand, Total wall contact time (WCT) was also recorded from the turning board to determine the proportion of the overall wall contact time spent pushing off [5]. No significant decrease of other training was observed within and between the groups. The results indicate that turn technique need the strength to produce the high force for swimmer in the footage performing a freestyle turn initiates the turn further from the wall which leads to a better position on the wall at contact. The foot position on the wall and body position at contact will lead to an efficient use of the propulsive push-off forces (alignment of feet, hips and shoulders and depth of foot contact are all in a beneficial position)[10].

Table 2: Comparison of 5mRTT, RT and WCT

Groups	5m RRT			RT			WCT		
	pre	post	**sig**	pre	post	**sig**	pre	post	**sig**
Strength (S)	2.372	2.295	0.02*	1.291	1.293	0.78	0.144	0.159	0.00**
Endurance (E)	2.433	2.422	0.97	1.301	1.302	0.98	0.152	0.155	0.23
Strength- endurance (SE)	2.354	2.344	0.70	1.293	1.292	0.76	0.136	0.139	0.45
Endurance– strength (ES)	2.576	2.578	0.34	1.312	1.313	0.23	0.133	0.130	0.33
Control (C)	2.764	2.753	0.97	1.319	1.316	0.96	0.139	0.144	0.74

Table 3: Comparison of PT, GD and 50FR

Groups	PT			GD			50FR		
	pre	post	**sig**	pre	post	**sig**	pre	post	**sig**
Strength (S)	0.257	0.261	0.98	0.687	0.677	0.98	29.32	30.23	0.48
Endurance (E)	0.263	0.266	0.67	0.632	0.266	0.67	32.21	31.89	0.87
Strength- endurance (SE)	0.278	0.272	0.44	0.735	0.272	0.44	30.23	30.33	0.12
Endurance– strength (ES)	0.277	0.275	0.33	0.753	0.275	0.33	33.67	32.98	0.31
Control (C)	0.268	0.265	0.78	0.645	0.265	0.78	31.79	32.11	0.45

CONCLUSION

Turning technique is an important component in overall swimming performance, with turn times positively correlating with the final event times. Until recently, little was known about the effect of the differences training on the freestyle turns. The results of this study indicate that the strength training can reduce the turn time.

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