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Effect of Basic Endurance Training on the Level of Maximum Oxygen Consumption and the Recorded Achievement for Junior Swimmers 400m Freestyle Stroke

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Abstract: The current research aims to design a recommended training program for improving basic endurance and identifying its effects on VO2max and the recorded achievement for junior swimmers (400m freestyle stroke). The researcher used the experimental approach with one group (pre/post- measurements) on a sample of 8 swimmers from Al-Ahly Sports Club. Basic endurance level was identified by T-3,000 test. The training program was for 8 weeks. Results showed significant improvements on basic endurance, VO2max and recorded achievement of 400m freestyle stroke. Coaches should concentrate on relative loads of basic endurance training for junior swimmers as it affects positively the studied variables.

Key words: Basic endurance % Basic endurance indicators % VO2max

INTRODUCTION

Egyptian records in freestyle swimming [1] are still very far away from world levels [2] as shown in Table 1.

The recorded level increases with the increase of race distance. Thus, the need for aerobic training increases to improve endurance and concentrate far more better on technical performance. Rateb [3] indicated that the most important aspect for junior swimmers is developing endurance and technical performance as it has a great importance in developing body physiological systems connected to aerobic work. Abd El-Maksoud [4] indicated the importance of endurance training for junior swimmers as it leads to improving the physical fitness components.

Helmy [5] indicated the importance of establishing a solid base of skills and endurance for junior swimmers to enable them achieve future success and warned about using anaerobic training that may lead to good quick results that are not useful on the long run. He also sees that this type of anaerobic training is one reason for the underdevelopment of Egyptian swimming. Al-Kot [6] indicated that endurance is the result of high aerobic capacity and is connected to cardio-pulmonary systems needed greatly by 400m or more swimmers. The aerobic capacity is the capacity to consume, transport and utilize oxygen and is measured by maximal oxygen consumption (VO2 max). Endurance swimmers should be characterized by high aerobic capacity as the swimmer with high VO2max has a higher ability for endurance and performance.

Table 1: Egyptian records in freestyle swimming

Distance	World Record	Egyptian Record	Difference in sec.
50m freestyle	20.25	22.25	1.34
100m freestyle	46.91	51.17	4.26
200m freestyle	1:42.00	1:52.27	10.27
400m freestyle	3:40.07	3:56.49	16.42
800m freestyle	7:32.12	8:12.61	40.49
1500m freestyle	14:34.56	15:45.84	1:11.28

[1]Records until December 2009.

[1]Records until October 2009.

Maglischo [7] showed that swimming training can be identified according two terms: endurance training for developing aerobic work and speed training for developing anaerobic work. He assured the importance of designing training programs very carefully to enable the swimmer to reach a high level according to his/her abilities and age group. Maglischo [8] categorized endurance training under three levels: Level one: Basic endurance training (En-1). Level two: Anaerobic threshold endurance training (En-2). Level three: Overload endurance training (En-3).He indicated that (En-1) training enhances aerobic abilities in oxygen consumption and removal of lactic acid and thus improves swimming performance. It used with

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50-60% of weekly volume as swimmers swim slower than usual so that their anaerobic threshold is in harmony with longer distances with moderate speeds.

Several studies discussed levels of endurance. Boten *et al*. [9] discussed the effect of speed and endurance training on swimming digital records for (100m and 400m) freestyle and VO2max. Sal [10] discussed the effect of using overload on duration of swimming performance while Costill and Thomas [11] discussed the adaptations resulted from swimming training. Kamel [12] discussed the effect of using different levels of endurance on VO2max and technical performance for junior swimmers while Ahmed [13] discussed the effectiveness of calibration of training load with reference to individual anaerobic threshold on the recorded level of junior swimmers. Also, Al-Kanawaty [14] discussed the efficiency of basic endurance training on some component of physical fitness and the recorded achievement for breast junior swimmers.

According to the researcher's knowledge, non of these studies discussed the effect of basic endurance (En-1) alone on VO2max and the recorded level for junior swimmers who, in this age group, need such a moderate level of speed in training to enable them concentrate on technical performance as a basic to improving the recorded level. Thus, the current research is a try to establish an experimental scientific base for coaches to identify the effect of using basic endurance training on VO2max and the recorded achievement for junior swimmers (400m freestyle stroke).

The aim of this research is to design a recommended training program for improving basic endurance to identify the effect of the recommended program on VO2max for 400m freestyle junior swimmers and the effect of the recommended program on the recorded level for 400m freestyle junior swimmers.

Hypotheses:

- There are statistical significant differences between the pre and post- measurements of basic endurance indicators for 400m freestyle junior swimmers.
- There are statistical significant differences between the pre and post- measurements of VO2max for 400m free style junior swimmers.
- There are statistical significant differences between the pre and post- measurements of the recorded level for 400m freestyle junior swimmers.

MATERIALS AND METHODS

The researcher used the experimental approach with one group (pre-/post- measurements) as it suites the research nature. Sample was chosen purposefully from intermediate distance swimmers in Al-Ahly Sports Club (Nasr City),aged 15-16 years with total number of 8 swimmers (75% of study community).

From Table 2, it is clear that sequills is between ±3, indicating that data is free from unusual distribution defects.

Tools and Equipments:

- A restamer for measuring heights.
- A medical balance for measuring weights.
- A Casio stop-watch (1/100) (Model HS-70w)

Tests:

- (T-3,000) test to identify anaerobic threshold speed and En-1 speed.
- 800m free style swimming test to identify relative VO2max
- 400m freestyle swimming test.

Statistical Treatments:

- Means.
- Standard deviation.
- Variance significance.
- Sequills.

Pre-Measurements:

- Basic variables (age - height - weight - 400m freestyle swimming duration) were taken on 3-11-2009 for sample members.
- T-3,000 swimming test was applied to identify the anaerobic threshold speed and En-1 speed according to the directives of Maglischo [8] on 4-11-2009.
- 800m freestyle swimming test was applied to identify relative VO2max using the schedules of weight and time that was mentioned by Al- Kot [6] on 5-11-2009.
- Table 3 shows the results of pre-measurements.

Program Design: According to pre-measurement data and T-3,000 results, the program was designed according to Maglischo guidelines [8] for constructing EN-1 sets.

Table 2: Basic variables of sample

Variable	Measurement	Means	SD (±)	Median	Skwness
Age	Year	15.37	0.52	15	0.64
Height	Cm	175.75	2.25	176.50	0.78
Wight	Kg	67.50	2.44	67.50	-
Training period	Year	5.37	0.51	5	0.64

From Table 2, it is clear that sequills is between ±3, indicating that data is free from unusual distribution defects.

Table 3: Pre-measurement time records and Vo2max of the sample

Variable	Measurement	Means	SD (±)	Median	Sequills
100m record as En-1	Second	81.32	0.20	81.35	-1.67
200m record as En-1	Second	161.55	0.63	161.48	-0.22
400m record as En-1	Second	326.78	1.29	326.75	0.10
recorded achievement (400m)	Second	279.38	7.01	279.50	-.15
VO2max	Ml/kg/min	56.59	0.57	56.50	1.02

From Table 3, it is clear that sequel is between ±3, indicating that data is free from unusual distribution defects.

Appendix 1: Basic endurance training program

Week	1							2							3							4						
Total volumetraining	35							38							40							42						
Percentage Of (en-1)	56 %							57 %							58 %							53 %						
(en-1)Volume training	19.6							21.7							23.2							22.3						
Day	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri
VolumeOfTrainingdose	1.8	2.6	2.3	2.7	2.2	2.5		2.1	2.9	2.4	3.0	2.4	2.6		2.3	3.1	2.6	3.2	2.6	2.8		2.3	2.9	2.6	2.8	2.5	2.6	
	1.7		1.9		1.9			2.0		2.1		2.2			2.0		2.3		2.4			2.1		2.2		2.3		
Components	10 ×50		kick		(: 10 sec)			10 ×50		kick		(: 10 sec)			400		pull		(: 40 sec)			2× 400		kick /pull		(: 40 sec)		
Of Trainingdose	300		Drill		(: 30 sec)			4 × 50 stroke count				(: 20 sec)			500		kick		(: 50 sec)			4 ×100		drill		(: 20 sec)		
	4× 200		(En-1)		(: 30 sec)			4 × 200		drill		(: 40 sec)			10 ×50		drill		(:20 sec)			4× 300		(En-1)		(: 40 sec)		
								3 × 200		(En-1)		(: 30 sec)			4× 200		(En-1)		(: 30 sec)			4 × 50 stroke count				(: 20 sec)		
Intensity	120 ---------- 150 (b p m)																											

Appendix 2: Basic endurance training program

Week	5							6							7							8						
Total volume training	45							42							40							34						
Percentage Of (en – 1)	51%							46%							44%							42%						
(en – 1) Volume training	22.9							19.3							17.6							16.4						
Day	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri	Sat	Sun	Mon	Tue	wed	Thu	Fri
	2.4	3	2.6	3	2.6	2.7		1.7	2.5	2.3	2.7	2.2	2.5		1.6	2.3	2.2	2.4	2	2.2		1.4	2.1	2	2.2	1.8	2.1	
Volume Of Training dose	2.1		2.2		2.3			1.6		2		1.8			1.5		1.6		1.8			1.5		1.7		1.6		
Components	2 ×400		kick / pull		(: 40 sec)			8 × 100		kick / pull		(: 20 sec)			5 × 100		kick		(: 20 sec)			6× 50		kick			(: 20 sec)	
Of	2× 200		Drill		(: 30 sec)			4 × 100		drill		(: 20 sec)			4 × 100		drill		(: 20 sec)			4 × 50		drill			(: 10 sec)	
Training dose	2× 500		(En- 1)		(: 45 sec)			3 × 400		(En- 1)		(: 40 sec)			800		(En- 1)		(: 50 sec)			8 × 100		(En-1)			(: 20 sec)	
	8 × 100		(En-1)		(: 20 sec)			6 × 50 stroke count				(: 20 sec)			10× 50 stroke count				(: 20 sec)			8× 50 stroke count					(: 20 sec)	
Intensity	120 ---------- 150 (b p m)																											

General preparation and specific preparation phases were chosen to apply the program. The duration of these two phases was 8 weeks with 9 training units per week. Total training units number was 72 units. Total training volume was 3.5-6.5 Km / day and weekly training volume was 35 - 45 Km / week.All the program details (volume - repetition - intensity - rest) are illustrated in Appendixes 1 and 2. The training program was applied from 7-11-2009 to 31-12-2009

Post-Measurements:

- Recorded level for 400m freestyle swimming was measured on 2-1-2010.
- 800m freestyle swimming test for identifying relative VO2max was applied on 3-1-2010
- (T-3,000) test for identifying anaerobic threshold speed and En-1 speed was applied on 4-1-2010.

Table 4: Variance significance between pre and post- measurements of 100m, 200m and 400m free style swimming records as an indicators of basic endurance

	Pre-measurement		Post-measurement				
Variable	Means	SD ±	Means	SD ±	Variance means	Variance significance	(t)
100m freestyle record	81.32	0.20	78.37	0.74	2.94	0.70	11.83*
200m freestyle record	161.55	0.63	158.50	2.77	3.05	3.01	2.87*
400m freestyle record	326.78	1.29	316.25	0.71	10.53	0.81	35.95*

*P#0.05 = 1.89

Table 5: Variance significance between pre and post- measurements of VO2max for 400m swimmers

	Pre-measurement		Post-measurement				
Variable	Means	SD ±	Means	SD ±	Variance means	Variance significance	(t)
VO2max	56.59	0.57	57.24	0.68	0.65	0.14	13.00*

*P#=0.05 = 1.89

Table 6: Variance significance between pre and post- measurements of recorded achievement level for 400m swimmers

	Pre-measurement		Post-measurement				
Variable	Means	SD ±	Means	SD ±	Variance means	Variance significance	(t)
Recorded achievement (400m)	279.38	7.01	272.75	6.71	2.62	0.74	25.18*

*P#0.05 = 1.89

RESULTS AND DISCUSSION

From Table 4, there are statistical significant difference between pre- and post-measurements on 100m, 200m and 400m records as an indicator of basic endurance in favor of post-measurement.

From Table 5, there are statistical significant difference between pre and post-measurements on VO2max in favor of post-measurement.

From Table 6, there are statistical significant difference between pre- and post-measurements on digital achievement level in favor of post-measurement.

Table 4 showed the variance significance between pre- and post- measurements of 100m, 200m and 400m freestyle swimming records as an indicator of basic endurance. It is clear that there are statistically significant difference between pre- and post-measurements on 100m, 200m and 400m records as an indicators of basic endurance in favor of post-measurement on P#0.05. This is due to the calibration of loads on distances (100m, 200m and 400m) used in the program. These results are in agreement with Maglischo [8] as En-1 training improves aerobic capacity, glycogen consumption and lactic acid removal leading to better competition results.

Table 5 showed that there is a statistical significant difference between pre and post-measurements on VO2max in favor of post-measurement. The researcher thinks that moderate speeds used in performing (100m, 200m and 400m) distances as basic endurance in the program led to more concentration on technical performance and improving the recorded level. This is in agreement with Rateb [3] who indicated that we should concentrate on improving endurance and technical level as it enhances the functioning of physiological systems connected to aerobic work. It is also in agreement with Mosa [15] in that endurance training helps in improving the functional efficiency of body systems and elevating the training conditions of swimmers that in turn leads to improving (400m and 800m) recorded level.

Table 6 showed statistical significant difference between pre and post-measurements on recorded achievement level of 400m free style swimming in favor of post-measurement. This is due to the application of training loads taken from T-3,000 test according to Maglischo [8] to measure swimming speed of basic endurance training as this speed affected positively the recorded level. This is in agreement with Costill and Thomas [11] as endurance training affects positively the recorded levels of swimming.

CONCLUSION

The Researcher Concluded That:

- The training program improved the results of T-3,000 test and it indicators.
- Basic endurance training improved VO2max.
- Basic endurance training plays an effective role to improve the recorded level of 400 m freestyle for junior swimmers.

Recommendation:

- The basic endurance training program should be applied to all age groups of junior swimmers.
- More studies should a$dress basic endurance for different distances and methods of swimming.
- Coaches should concentrate on integrating basic endurance training in their training programs for all age groups and all training phases.

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