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Influence of aquatic training on selected physical fitness variables among volleyball players

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Abstract

The purpose of this study was to analyze the aquatic training on selected physical fitness variables among volleyball players. To achieve this, 40 physically active and interested undergraduate engineering volleyball players were selected as subjects and their age ranged between 18 and 20 years. The subjects were categorized into two groups namely control group, aquatic training group with each 20 subjects. The experimental group underwent the experimental treatment for 12 weeks, 3 days per week and a session on each day with 45 min duration. Speed, endurance and explosive power were taken as variables for this investigation. Fifty meters run, cooper 12 min run and standing vertical jump were used as test. The data collected prior and after the experimental treatment was analyzed using analysis of covariance (ANCOVA). The result revealed that aquatic training group shows significant improvement in all the selected physical fitness variables.

Keywords: Aquatic training, speed, endurance, explosive power, volleyball, sports improvement

Introduction

The benefits of aquatic exercise originate from the supportive nature of the water environment, muscular strengthening and toning of muscles which result from the resistive properties of water as a dense liquid. Water has several properties that make it an ideal environment for exercise. The buoyancy experienced in water reduces body weight and makes many exercises possible while reducing stress on joints. Buoyancy is the force that water applies in an upward direction against gravity. The buoyant force provided by water decreases the player's weight in relation to the degree of submersion and decreases the amount of force and joint compression during landing. The buoyancy effect of water makes aquatic training an optimal exercise environment for the players and individuals as impact and stress on joints is reduced (Gappmaier *et al.,* 2006). The buoyancy of water supports the submerged body from the downward pull of gravity, providing up to a 90% reduction in body weight (DiPrampero, 1986; Darby & Yaekle, 2000; Wilder & Brennan, 2004). Benefits of this buoyant effect include less stress and pressure on bone, muscle and connective tissue while the viscosity and drag force of water provides a resistance proportional to the exerted effort (Wilder & Brennan, 2004). When the velocity of movement doubles, the drag force produced by water quadruples providing a resistance training stimulus (Tsourlou *et al.,* 2006). As the density of water is approximately 800 times that of air (DiPrampero, 1986), the buoyant properties of water reduce forces on the musculoskeletal system thereby decreasing the risk of overuse injuries such as tendonitis and stress fractures.

Aquatic training resulted in similar training effects as land-based training with a possible reduction in stress due to the reduction of impact afforded by the buoyancy and resistance of the water upon landing (Stemm & Jacobsen, 2007). Aquatic exercise does not worsen the joint condition or result in injury (Wang, 2006). The resistance of the water promotes strengthening. Water acts as a variable 'accommodating' resistance (Prins, 2009). An aquatic training programme can decrease compression forces, vibration forces and torsional forces that a player may ensure while training on land (Roswell, 2009). In recent years aquatic training became one of the most important training to improve the physical and physiological variables (Krishnan *et al.,* 2005). The purpose of this study was to analyze the aquatic training on selected physical fitness variables among volleyball players.

Methods

Forty physically active and interested undergraduate engineering volleyball players were randomly selected as subjects and their age ranged between 18 and 20 years. The subjects are categorized into two groups namely control group (CG), aquatic training group (ATG) and each group had 20 subjects. The selected criterion variables speed was assessed by 50 m run; endurance was assessed by coopers 12 min run test and explosive power was assessed by standing vertical jump. The aquatic training group underwent the experimental

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treatment for 12 weeks, 3 days/week and a session on each day with 45 min duration.

Aquatic training

Warm-up exercise was performed in ground and water. The water level was just above the hip level. After that the aquatic training group performed the following aquatic exercises. 1. Single leg jump (alternative leg), 2. Double leg jump, 3. High knee action, 4. Walking and 5. Aerobic exercise. These exercises were performed for 45 min in a day and for 3 days/week. Pre and post test data were collected before and after 12 weeks of training. The collected data was analyzed using analysis of covariance (ANCOVA).

Statistical analysis

The means and standard deviations of both control and aquatic training groups were calculated for speed, endurance and explosive power for the pre as well as post tests. The collected data was analyzed using analysis of covariance (ANCOVA). ANCOVA was used to examine significance between testing groups (CG & ATG). Statistical significance was set to a priority at $p < 0.05$. All statistical tests were calculated using the statistical package for the social science (SPSS) for Windows (Version 15).

Results

Table 1 show that the pre and post test means and standard deviation of control and aquatic training groups on speed. The obtained 'F' value for pre and post test means on speed was 0.29 and 3.90 respectively, which was lesser than table value of 4.09 for degree of freedom 1 and 38 at 0.05 level of confidence; hence there was no significant difference in pre and post test data of control and aquatic training groups. The analysis of adjusted post test mean data reveals that obtained 'F' value of 19.78 was greater than table 'F', hence there exist difference in speed among the CG and ATG groups.

Table 1. analysis of covariance for speed for control and aquatic training groups

Test	Control group (CG)	Aquatic training group (ATG)	Sources of variance	Sum of the squares	df	Means squares	F-ratio
Pre test Mean SD (±)	7.56	7.58	BG	0.04	1	0.004	0.29
	0.35	0.38	WG	5.26	38	0.13	
Post test Mean SD (±)	7.52	7.27	BG	0.62	1	0.62	3.90
	0.32	0.46	WG	6.07	38	0.16	
Adjusted post test mean	7.52	7.26	BS	0.72	1	0.72	
			WS	5.62	37	0.148	19.78*

** Significant at 0.05 level*

Table 2 reveals that the pre and post test means and standard deviation of control and aquatic training groups on endurance. The obtained 'F' value for pre and post test means on speed was 0.09 and 1.12 respectively, which was lesser than table value of 4.09 for degree of freedom 1 and 38 at 0.05 level of confidence; hence there was no significant difference in pre and post test data of control and aquatic training groups. The analysis of adjusted post test mean data reveals that obtained 'F' value of 84.85 was greater than table 'F', hence there exist difference in endurance among the control group and aquatic training group.

Table 3 indicates that the pre and post test means and standard deviation of control and aquatic training groups on explosive power. The obtained 'F' value for pre and post test means on speed was 0.06 and 0.63 respectively, which was lesser than table value of 4.09 for degree of freedom 1 and 38 at 0.05 level of confidence; hence there was no significant difference in pre and post test data of control and aquatic training groups. The analysis of adjusted post test mean data reveals that obtained 'F' value of 63.66 was greater than table 'F', hence there exist difference in explosive power among the control group and aquatic training group.

Discussion

Aquatic-based exercise intervention, the resistive properties of water provided a resistive stimulus

Table 2. analysis of covariance for endurance for control and aquatic training groups

Test	Control group (CG)	Aquatic training group (ATG)	Sources of variance	Sum of the squares	df	Means squares	F-ratio
Pre test Mean SD (±)	2168.50	2145.00	BG	5522.50	1	5522.50	
	224.66	252.03	WG	2165955	38	56998.81	0.09
Post test Mean SD (±)	2137.50	2212.50	BG	56250.00	1	56250.00	
	203.15	243.04	WG	19606550	38	50172.36	1.12
Adjusted post test mean	2126.59	2223.40	BS	93485.17	1	93485.17	
			WS	140765.35	37	1101.76	84.85*

** Significant at 0.05 level*

regardless of whether specific resistance training exercises are prescribed. An aquatic-based exercise demonstrated positive alterations in lower body strength. The majority of these studies suggest that adding deep-water running to an athlete's training regimen has the potential to increase fitness and ultimately improve performance (Burns & Lauder, 2001). The aquatic environment may be used to provide a workload sufficient to create fatigue and produce strength gains in both de-conditioned adults and trained athletes (Tsourlou *et al.,* 2006).

According to Evans (1978) the dual effects of buoyancy and resistance make possible high levels of energy expenditure with relatively little movement or strain on lower-joint extremities. Additionally, enhanced temperature regulation during water exercise makes this an ideal environment for obese individuals who have an increased risk of heat intolerance (Wallace, 2003). Martel (2005) demonstrated the ability to increase vertical jump in female volleyball players using specific aquatic plyometric training and these improvements could be accomplished with less muscle pain as well.

Table 3. Analysis of covariance for explosive power control and aquatic training groups

Test	Control group (CG)	Aquatic training group (ATG)	Sources of variance	Sum of the squares	df	Means squares	F-ratio
Pre test Mean SD (±)	46.20	45.75	BG	2.02	1	2.02	0.06
	5.75	5.67	WG	1240.95	38	32.65	
Post test Mean SD (±)	47.40	48.9	BG	22.50	1	22.50	0.63
	6.13	5.76	WG	1346.60	38	35.43	
Adjusted post test mean	47.16	49.13	BS	38.54	1	38.54	63.66*
			WS	22.39	37	0.60	

** Significant at 0.05 level*

Conclusion

Aquatic training group (ATG) showed significant improvement in all selected physical fitness variables namely speed, endurance and explosive power among volleyball players after aquatic based exercise training intervention. However the control group (CG) had not shown significant change in any of the selected variables.

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