ISSN: 2349 - 4891

International
Journal of Recent Research and Applied Studies
(Multidisciplinary Open Access Refereed e-Journal)

Effect of Different Plyometric Training on Biomechanical and Physiological Parameters of College Men Students

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Received 3rd April 2016, Accepted 1st June 2016

Abstract

The aim of this study was to compare the effect of twelve weeks plyometric and aquatic plyometric training on some biomechanical variables including agility, leg strength and $vo_{2\ max}$ in college men students. The study was ninety subjects were randomly selected from Alagappa Govt Arts College, Karaikudi, and Tamil Nadu. The subject's age ranged between 18-25 years. They were randomly divided into three equal groups. Aquatic plyometric training group, plyometric training group were considered as two experimental groups and the other group was control group. Analysis of co-variance (ANCOVA) and scheffe's post hoc tests were used to examine the significance between the variables for testing groups. The analysis was carried out using SPSS version in 20.0 and statistical significance was set to a priority at $p < 0.05$. Plyometric training group and aquatic plyometric training group significantly improved agility, leg strength and vo2 max of the college students compared to control group. Aquatic plyometric training is better improvement of compared plyometric training group on agility and leg strength. There was no significant difference between aquatic plyometric training group and plyometric training group of $vo_{2\ max}$. It seems that plyometric training in water can be an effective technique to improve biomechanical variables in college students.

Keywords: Plyometric, Agility, Leg Strength and $Vo_{2\ max}$.

Introduction

Plyometrics is a type of training involving jumping; bounding and other high impact exercises that focus on maximizing the stretch reflex of the muscles. To teach the muscles to produce maximum force faster, this enhances performance for athletes and exercisers alike. *(Chu, Donald, 1998).*Aquatic plyometric training is not a new concept, but it has recently become more popular, mostly because of the potential to decrease injuries, compared with land plyometric contractions, by decreasing impact forces on the joints. Aquatic plyometric training provides a form of training that can enhance performance during a competitive season for a power-based sport *(Miller et al., 2002; Robinson et al., 2004).* It is suggested that Aquatic plyometric training has the potential to provide similar or better improvements in skeletal-muscle function and sport-related attributes of explosive and reactive training than land based plyometrics. According to *Coetzee (2007),* research has shown that aquatic plyometric programmes provide the same or even more performance enhancement benefits than land plyometric programmes.

The recent growth in aquatic activities is due in part to the properties of the water (i.e., resistance and buoyancy). Water creates a "non-impact medium" that produces little strain on muscle, bones, and connective tissue when compared with land activities. Water also provides buoyancy that reduces weight-bearing stress; however, movement in water increases the resistance. An increase in resistance results in a greater workload. Weight bearing activities on land places stress on the lower limbs, and this stress is considerably reduced in water due to its buoyancy. Although water reduces the effects of weight-bearing on the skeletal joints while at rest, the resistive effect of water on joint movements provides exercise loading, enhancing muscular tension beyond that achieved on land. Aquatic training offers efficiency, comfort, safety, and training at any level of intensity. Performing exercises in the vertical plane maximizes resistance and increases turbulence and drag, which helps to strengthen the active muscle. It can also be expected that injury rate would be lower in water due to the buoyancy that water provides. Aquatic plyometric training can provide comparable training gains with reduced risk of injury, coaches and strength specialists would have a more viable training option for conditioning that would enhance performance while reducing the risk of injury.

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Objective of the Study

To find out the effectiveness of plyometric training and aquatic plyometric training on some biomechanical variables (agility, leg strength) and physiological variables ($vo_{2\ max}$) of the college men students.

Hypotheses

1. It was hypothesized that there was significant improvement on some biomechanical variables and physiological variables responses to twelve weeks Plyometric and aquatic plyometric Training.
2. It was hypothesized that there was significant difference on some biomechanical variables and physiological variables responses to twelve weeks Plyometric and aquatic plyometric Training.

Methodology

The aim of this study was to compare the effect of twelve weeks plyometric and aquatic plyometric training on some biomechanical variables including agility, leg strength and $vo_{2\ max}$ in college men students. The study was ninety subjects were randomly selected from Alagappa Govt Arts College, Karaikudi, and Tamil Nadu. The subject's age ranged between 18-25 years only. They were randomly divided into three equal groups. Aquatic plyometric training group, plyometric training group were considered as two experimental groups and the other group was control group. All the subjects were healthy and physically fit. The nature and importance of the study was explained to the subjects and subjects expressed their willingness to serve as subjects in this study. The study was formulated as pre and post test for experimental design. Independent Variables Such as a Group II -Aquatic plyometric training, Group I - Plyometric training and Control group - No training. Dependent Variables Such as biomechanical variables including agility, leg strength and physiological variables of vo2 max.

Table I. Tools Used for the Study

Sl. No	Criterion Variables	Test Items	Unit of measurements
1.	Agility	T test	in seconds
2.	Leg strength	1 RM Leg strength	Kilogram (Wx(36/(37-R))
3.	$Vo_{2\ max}$	Step test	beats per minutes

Training Programme

A 12-week plyometric-training program was developed that included weekly three days training sessions. And the same training was performed in the water belt for the aquatic training groups the duration of the training period was 90 minutes. Both groups performed the following aquatic exercises: Squat Jump. Split squat Jump, Two foot ankle Hop, Standing long jump and Alternative leg jump. Total number of foot contact 40-150, Rest Interval between Repetition-60 Sec, Rest Interval between Set-2 to 3 minutes. Observations were made for 12 weeks and then post test data were taken. Swimming pool with a depth of approximately 120 cm and temperature of 26° c to 28°C.

Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences for Windows version 20.0. The analysis of covariance and scheffe's post hoc test on the data obtained on agility, strength and $vo_{2\ max}$ of Experimental and Control groups and to identify any significant differences between the groups at the pre and post tests for the dependent variables at $P \leq 0.05$, respectively.

Results

Table I. Analysis of covariance for the control and experimental groups on agility (Scores in seconds)

	CONTROL GROUP	PLYOMETRIC GROUP	AQUATIC PLYOMETRIC GROUP	SOV	SS	df	MS	F RATIO
Pre test mean	13.03	13.13	12.60	**B**	4.822	2	2.411	**2.77**
				W	75.633	87	0.869	
Post test mean	13.00	12.53	11.60	**B**	30.459	2	15.244	**21.87***
				W	60.667	87	0.697	
Adjust post test mean	12.92	12.38	11.84	**B**	16.847	2	8.423	**37.91***
				W	19.105	86	0.222	

*Significant at 0.05 level.

The table value required for significance at 0.05 levels with df 2 and 87, 86 is 3.10.

Table-I shows the analyzed data on Agility assessed through t-test. Pre test means for control group, plyometric training group and aquatic plyometric training group were 13.03, 13.13 and 12.60 respectively. The obtained F ratio 2.77 was less than the required table value of 3.10. Hence the pre test was not significant. The post test means were, 13.00, 12.53 and 11.60 respectively. The obtained F ratio was 21.87 which were greater than the required Table value of 3.10. Hence the post test was significant at 0.05 level of confidence for the degrees of freedom 2 and 87.The adjusted post test means were 12.92, 12.38, and 11.84 respectively. The obtained F ratio was 37.91 which were greater than the required table value of 3.10. Hence it was significant at 0.05 level of confidence for the degrees of freedom 2 and 86.

Table II. Analysis of covariance for the control and experimental groups on 1 RM leg strength (Scores in kg)

	CONTROL GROUP	PLYOMETRIC GROUP	AQUATIC PLYOMETRIC GROUP	SOV	SS	df	MS	F RATIO
Pre test mean	88.83	91.50	92.80	**B**	245.35	2	122.67	**0.792**
				W	13476.46	87	154.90	
Post test mean	88.83	104.47	109.47	**B**	6951.35	2	3475.67	**20.91***
				W	14455.10	87	166.15	
Adjust post test mean	90.89	104.04	107.82	**B**	4653.20	2	2326.60	**73.98***
				W	2704.52	86	31.44	

*Significant at 0.05 level.

The table value required for significance at 0.05 levels with df 2 and 87, 86 is 3.10.

Table II shows the analyzed data on strength assessed through1 RM leg strength. Pre test means for control group, plyometric training group and aquatic plyometric training group were 88.83, 91.50 and 92.80 respectively. The obtained F ratio 0.792 was less than the required table value of 3.10. Hence the pre test was not significant. The post test means of 88.83, 104.47 and 109.47 respectively. The obtained F ratio was 20.91 which were greater than the required Table value of 3.10. Hence the post test was significant at 0.05 level of confidence for the degrees of freedom 2 and 87.The adjusted post test means of 90.89, 104.04, and 107.82 respectively. The obtained F ratio was 73.98 which were greater than the required table value of 3.10. Hence it was significant at 0.05 level of confidence for the degrees of freedom 2 and 86.

Table III. Analysis of covariance for the control and experimental groups on $vo_{2\ max}$ (Scores in beats per mints)

	CONTROL GROUP	PLYOMETRIC GROUP	AQUATIC PLYOMETRIC GROUP	SOV	SS	df	MS	F RATIO
Pre test mean	45.97	45.70	46.07	**Between**	2.156	2	1.078	**0.130**
				Within	719.13	87	8.266	
Post test mean	45.77	50.83	51.83	**Between**	634.75	2	317.37	**9.962***
				Within	2771.70	87	31.85	
Adjust post test mean	45.72	50.99	51.71	**Between**	641.92	2	320.96	**11.83***
				Within	2333.12	86	27.12	

*Significant at 0.05 level.

The table value required for significance at 0.05 levels with df 2 and 87, 86 is 3.10.

Table III shows the analyzed data on $Vo_{2\ max}$. Pre test means for control group, plyometric training group and aquatic plyometric training group were 45.97, 45.70 and 46.07 respectively. The obtained F ratio 0.130 was less than the required table value of 3.10. Hence the pre test was not significant. The post test means were, 45.77, 50.83 and 51.83 respectively. The obtained F ratio was 9.962 which were greater than the required Table

value of 3.10. Hence the post test was significant at 0.05 level of confidence for the degrees of freedom 2 and 87.The adjusted post test means for control group, plyometric training group and aquatic plyometric training group were 45.72, 50.99, and 51.71 respectively. The obtained F ratio was 11.83 which were greater than the required table value of 3.10. Hence it was significant at 0.05 level of confidence for the degrees of freedom 2 and 86.

Table IV. Scheffee's Post - hoc Test for Mean Differences between Groups of agility, Leg strength and $vo_{2\ max}$

	Control group	Plyometric group	Aquatic plyometric group	Mean Differences	C.I
Agility	12.92	12.38		0.54*	**0.27**
	12.92		11.83	1.07*	
		13.35	11.83	0.50*	
Leg strength	90.89	104.04		13.14*	**3.57**
	90.89		107.82	16.92*	
		104.04	107.82	3.78*	
$vo_{2\ max}$	45.72	50.99		5.27*	**3.29**
	45.72		51.71	5.90*	
		50.99	51.71	0.71	

* **Significant**

Table IV shows that the Agility mean difference values of control and Plyometric training, control and aquatic Plyometric training & Plyometric training and aquatic Plyometric training groups on speed were 0.54, 1.07 and 0.50 confidence interval value of 0.27. Leg strength were 13.14, 16.92 and 3.78 confidence interval value of 3.57.$vo_{2\ max}$ were 5.27 and 5.90 confidence interval value of 3.29 respectively which were greater than the confidence interval values at $p < 0.05$ level of confidence. Plyometric training and aquatic Plyometric training groups on $vo_{2\ max}$ were 0.71 is less than the confidence interval value of 3.29 hence no significance difference.

Discussion on Findings

The aim of this study was to relative the effects of 12 weeks of plyometric and aquatic plyometric training on some biomechanical variables including agility, leg strength and $vo_{2\ max}$ in college men students. Agility is usually involving stopping, starting and changing directions in an explosive manner. These movements are components, which can assist in developing agility. Several studies have suggested that plyometric training may enhance agility. The many studies proved that plyometrics had positive effect to improve the agility *Rameshkannan S.And Chittibabu.b (2014), Sethu. S (2014), Raj kumar (2013), Miller et al. (2006)*. A study proved that aquatic plyometrics had positive effect to improve the agility *Kamaraj.p et al (2013*).But there were limited studies compare with aquatic and land plyometrics on agility. Many of those studies proved that aquatic plyometrics as effective as the land plyometrics on agility and some of those were opposite. *Fattahi et al (2015) Hamid Arazi et al (2012), Shiran, M. Y .et al (2008), Jones (2008), Gulick et al. (2007)* pointed that there wasn't significant differences between land and aquatic plyometrics on agility. Recent study found similar result too but *Zarneviszadeh.Mahboobeh, et al (2014), David Leslie Fabricius (2011)* noticed that land plyometrics more effective method than the aquatic plyometrics on agility. Present studies also significant improved aquatic plyometric training groups is greater than land plyometric training group. Aquatic plyometrics can improve agility are due to the physical properties of water. Viscosity and cohesion of water increases this resistance, providing an important training stimulus for agility within an aquatic environment. Also, the collective effect of speed specificity, repetitive jump training with the shorter amortization phase, could too result in improved agility *(Behm and Sage, 1993*).In $vo_{2\ max}$,aquatic plyometric training group and plyometric training group no significant difference of vo_2 max. Between the experimental groups better improvement of compare control groups. *Joshua Wortman (2012), Brown GA et al (2010) and Nisithkumar Datta, Rakesh Bharti (1999*) in this studies significant improvement of $vo_{2\ max}$ compared plyometric training and control group. Previous studies did not found in any significance improvement of aquatic plyometric training group and plyometric training groups. *Cassady SL, Nielsen DH (1992*) in this study evaluated the oxygen consumption (VO_2) for standardized upper and lower extremity exercise on land and in water. In this study water exercise is better than vo_2 in land exercises. *Darby La, Yaekle Bc (2000)* found compare heart rate for similar upright exercises performed on land and in water. Water exercise was performed at $vo_{2\ max}$ comparable to during land exercise.

Conclusion

Plyometric training group and aquatic plyometric training group significantly improved agility, leg strength and $vo_{2\ max}$ of the college men students compared to control group. Aquatic plyometric training is better improvement of compared plyometric training group on agility and leg strength. There was no significant difference between aquatic plyometric training group and plyometric training group of $vo_{2\ max}$. plyometric exercises in water, it is proposed that aquatic plyometric training could provide similar benefits as land-based plyometrics, but with lower risk of muscle soreness or overtraining.

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