THE EFFECT OF PLYOMETRIC TRAINING PROGRAM ON AGILITY, POWER AND RESTING HEART RATE OF ADOLESCENT BOYS.

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Abstract

The purpose of the study was to determine if eight weeks of plyometric training can improve an athlete's agility power and Resting Heart rate. Subjects were divided into two groups, plyometric training and a control group. The plyometric training group performed in an eight week plyometric training program and the control group did not perform any plyometric training techniques. All subjects participated in Illinois Agility Test, standing broad jump test and a Resting heart rate tests both pre and post testing. Univariate ANCOVA were conducted to analyze the change scores (post — pre) in the independent variables by group (training or control) with pre scores as covariates. The Univariate ANCOVA revealed a significant group effect F = 34.77, p = 0.000, for the Illinois agility test measure. For the Standing broad Jump test, a significant group effect F = 27.52, p = 0.000 was also found. The plyometric training group had quicker posttest times compared to the control group for the standing broad jump tests. There is no significant group effect F = 2.41, p = 0.132 was found for the Resting heart rate test, when using the Pre-test values as a covariate.. The plyometric training group slightly reduced pulse rate on the posttest compared to the control group. The results of this study show that plyometric training can be an effective training technique to improve an athlete's agility and explosive power.

Key Words: Jumping, training, variables, quickness, agility, power resting heart rate.

Introduction

Children and adolescents need to participate regularly in physical activities that enhance and maintain cardiovascular and musculoskeletal health. While boys and girls have traditionally been encouraged to participate in aerobic training and strength building activities, a growing number of children and adolescents are experiencing the benefits of plyometric training. Plyometric refer to exercises that link strength with speed of movement to produce power and were first known simply as "jump training." Previously thought of as a method of conditioning reserved for adult athletes, the American College of Sports Medicine (ACSM) contends that plyometric training is a safe, beneficial and fun activity for children and adolescents provided that the program is properly designed and supervised.

Methods

In this study forty five adolescents boys were recruited from St.Joseph Matric & Higher Secondary School Chengalpet, Tamilnadu, India to serve as subjects for this stuTy7TOfind out the treatment effect, the investigator had determined that whe ther the subjects were not having participated regularly in any training for at least three months or more. The acceptable age range was 12-15 years of age and medical examination was conducted by a qualified physician.

Table-I - Demographic data. Data are means (±SD).

Group	N	Age	Height (cm)	Weight (kg)
Plyometric Training Group	15	14.20±1.50	145.10±8.7	36.80±8.60
Control group	15	13.53±1.06	148.33±7.5	42.26±7.94

Procedures

All subjects agreed not to change or increase their current exercise habits during the course of the study. The plyometric training group participated in a 8-week training program performing a variety of plyometric exercises designed for the lower extremity (Table 2), while the control group did not participate in any plyometric exercises. Prior to the study, procedures and guidelines were presented orally and in written form.

An 8-week plyometric training program was developed using three training sessions per week. The training program was based on recommendations of intensity and volume from Piper and Erdmann (1998), using similar drills, sets, and repetitions. From a physiological and psychological standpoint, six to eight weeks of moderate intensity power training is an optimal length of time for the CNS to be stressed without excessive strain or fatigue (Adams et al., 1992). It is the belief of some sports physiologists that neuromuscular adaptations contributing to explosive power occur early in the power cycle of the periodization phase of training (Adams et al., 1992). Plyometrics were only performed three days per week to allow for sufficient recovery between workouts as recommended by researchers (Adams et al., 1992). Training volume ranged from 80 foot contacts to 140 foot contacts per session while the intensity of the exercises increased for five weeks before tapering off during week six as recommended by Piper and Erdmann (1998) and used previously in another study (Miller et al., 2002). The intensity of training was tapered so that fatigue would not be a factor during post-testing. The plyometric training group trained at the same time of day, three days a week, throughout the study. During the training, all subjects were under direct supervision and were instructed on how to perform each exercise.

The standing broad jump test (AAHPERD) the athlete stands behind a line marked on the ground with feet slightly apart. A two foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed. Illinois Agility Test the length of the course is 10 meters and the width (distance between the start and finish points) is 5 meters. Four cones are used to mark the start, finish and the two turning points. Another four cones are placed down the center an equal distance apart. Each cone in the center is spaced 3.3 meters apart. Subjects should lie on their front (head to the start line) and hands by their shoulders. On the 'Go' command the stopwatch is started, and theathlete gets up as quickly as possible and runs around the course in the direction indicated, without knocking the cones over, to the finish line, at which the timing is stopped. The measurement of resting heart rate (the number of heart beats per minute) was taken after the subjects were lie down for at least 10 minutes before taking a measurement. Taking a radial or carotid pulse measurement (at the wrist or neck) is usually the easiest method.

Statistical Analysis

Pre and post values for the dependent variables were analyzed to determine the training effect. Change scores (post — pre) were computed for each of the dependent variables:, Illinois

Agility Test , AAHPERD Standing broad Jump Test and the Palpation Resting heart rate test. The ANCOVAs were used to test for differences between groups (Control, Plyometric Training) for the dependent var iable change scores using the pretest values as a covariate. Alpha was established a priori at p < 0.05. The Statistical Package for Social Science (version 16.0) was used to calculate the statistics.

Results

Table —II - Fitness Performance and Resting Heart Rate at Pre and Post Training. Data are presented as the mean (± SD).

Variable	Group	Pre Test	Post Test	Mean diff	%
Agility	Plyometric	18.93(.65)	17.68(.60)	-1.25(-.05)	-6.6(7.7)*
	Control	19.11(1.11)	19.18(128)	.07(0.17)	0.36(13.28)
Power	Plyometric	1.27(.15)	1.45(.13)	0.18(-.02)	12.41(13.3-3)*
	Control	1.36(.18)	1.37(.17)	.01(-.01)	0.73(5.56)
Resting Heart rate	Plyometric	81.20(3.67)	80.80(3.09)	-0.40(-0.58)	0.49(15.80)
	Control	82.87(6.93)	83.06(6.83)	-0.19(-0.10)	0.22(1.44)

* Indicates significant change (post — pre) when using Pre-test score as a covariate, < 0.05.

Table-ID-Analysis of variance on Pretest, Posttest and Adjusted means of Agility

	Plyometri cTraining	Control	Source of variance	Sum of square	df	Mean square	F-ratio
Pre-test	18.93	19.11	B/G	.241	1	.241	.291
			W/G	23.21	28	.829	
Post-test	17.68	19.18	B/G	17.07	1	17.07	16.97
			W/G	28.17	28	1.01	
Adjuste dmean	17.76	19.11	B/G	13.58	1	13.58	34.77
			W/G	10.54	27	.390	

Table -IV-Analysis of Co-Variance on Pretest, Posttest and Adjusted means of Power

	Plyometric Training	Control	Source of variance	Sum of square	df	Mean square	F-ratio
Pre-test	1.27	1.36	BIO	.058	1	.058	2.22
			WIO	.732	28	.026	

TABLE -V-Analysis of Co-Variance on Pretest, Posttest and Adjusted means of Resting Heart Rate

	Plyometric Training	Control	Source of varianc	Sum of square	df	Mean square	F-ratio
Pre-test	81.20	82.87	BIO	20.83	1	20.83	.678
			WIO	860.13	28	30.72	
Post-test	80.80	83.06	BIG	38.53	1	38.53	1.37
			WIG	787.33	28	28.12	
Adjusted mean	81.58	82.30	BIO	3.75	1	3.75	
			WIO	41.90	27	1.55	

Tests of normality indicated that dependent variables were normally distributed. The ANCOVA revealed a significant group effect F = 34.77, p = 0.000, lin' the Illinois agility test measure change score, when controlling for Pre-test Ili &Fences. As shown in Table 2, the plyometric group improved their Illinois agility limes by —1.25 ± 0.5 sec, while the control group times were virtually unchanged 0.07 1 0.17 sec. For the Illinois test . Standing broad Jump test change score, a significant pap effect F = 27.52, p = 0.000, was found, when controlling for Pre-test differences. The plyometric training group improved their Standing broad Jump Test distance by 0.18 ±'0.02 centimeter and the control group times changed by —0.01 1 0,01 centimeter. There is no significant group effect F = 2.41, p = 0.132 was found fi a. the Resting heart rate test, when using the Pre-test values as a covariate. The plyometric training group changed Resting heart rate test by —0.40 ± 0.58 counts and tlie control changed their count by —0.19 ±0.10count.

Discussion

For the Illinois agility test, times were improved by 6.6%, for the power (standing broad Jump test) were improved by 12.41%, and for the Resting heart rate lest , subjects slightly changes by 0.5%. By finding significant differences for agility and explosive power tests, our results indicate that the plyometric training improved times in the agility test measures and improved distance in the leg explosive power because of either better motor recruitment or neural adaptations. In a previous study plyometric training, the authors speculated that improvements were a result of enhanced motor unit recruitment patters (Potteiger et al. 1999). Neural adaptations usually occur when athletes respond or react as a result of improved coordination between the CNS signal and proprioceptive feedback (Craig, 2004). However, we eta ild not determine if neural adaptations occurred via synchronous firing of the motor neurons or better facilitation of neural impulses to the spinal cord which also supports the suggestions of Potteiger et al. (1999). Therefore, more studies are needed to determine neural adaptations as a result of plyometric training and how it affects agility.

We chose to use a standing broad jump test to determine the explosive power which is a major component for the entire sports event. The Plyometric training programme can increase the explosive power as evidenced by this study and others such as Rubley MD, Haase AC, Holcomb WR, Girouard TJ, Tandy RD.(J Strength 'laid Res. 2009 Dec) can also have significant effect in increasing the leg power specific to vertical jumping. Meylan C, Malatesta D believes this results the training gimp followed an 8-week plyometric program (i.e., jumping, hurdling, bouncing, skipping, and footwork) implemented as a substitute for some soccer drills to obtain thesame session duration as CG. At baseline and after training, explosive actions ware assessed with the following 6 tests: 10-meter sprint, agility test, 3 vertical jump tests (squat jump [SJ], countermovement jump [CMJ], contact test [CT] and multiple 5 bounds test [MB5]). Plyometric training was associated with significant increases in jump height for the CMJ (+7.9%) and CT (+10.9%) . There is no significant change in agility and explosive actions after the 8-week period were recorded for the Control group.

The reductions in resting heart rate with training were generally small in the Plyometric training group and others such as Wilmore JH, Stanforth PR, Gagnon J, Rice T, Mandel S, Leon AS, Rao DC, Skinner JS, Bouchard C , studied HR and BP at rest and during exercise (50 W, 60% of VO2m ax maximal exercise) were each determined in duplicate on two different days both before and after training (resting values at 24-h and 72-h post training). After the period of training, there was a small decrease in resting HR (-2.7 to -4.6 beats x min (-1) across groups at 72-h post training), and small changes (i.e., < 3 mm Hg) in resting systolic (SBP), diastolic (DBP), and calculated mean BP (MBP), which varied by race, sex, and age. The resting heart rate was no changes in control group.

Conclusions

The results from our study are very encouraging and demonstrate the benefits plyometric training can have on agility and explosive power. Not only can athletes use plyometrics to break the monotony of training, but they can also improve their strength and explosiveness while working to become more agile and power. In addition, our results support that improvements in agility and explosive power can occur in as little as 8 weeks of plyometric training which can be useful during the last preparatory phase before in-season competition for athletes, but there was no significant improvement in resting heart rate after 8 weeks of plyometric training for adolescent boys.

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