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Relative Effects of Isolated Combined and Complex Resistance Training on Selected Strength Speed and Power Parameters among College Men Students

[1]Dr.D.Rajalakshmi, [2]R. Ramya, [3]Amit Pramanik

Abstract*--The purpose of the study was to analyse the relative effect of isolated combined and complex resistance training on selected strength, speed and power parameters among College Men Students. To achieve the purpose of the study from the population of 40 College Men students those who have participated and their age of the subjects ranged from 16 to 19 years, height ranged from 160-168 centimetres and weight ranged from 54-64 kilograms were in summer coaching camp conducted by Sports Development Authority of Tamil Nadu, Thanjavur Unit, India. The selected participants were randomly assigned into four groups of ten participants each (n=10). Group I underwent weight training (WT), group II underwent plyometric training(PT), group III underwent combined training (WPT) (weight and plyometric training) and group IV underwent complex resistance training (C*T). The purpose of the study was to analyse the relative effect of isolated combined and complex resistance training on selected strength, speed and power parameters among College Men Students. To achieve the purpose of the study, from the population of 40 College Men students those who have participated and their age of the subjects ranged from 16 to 19 years, height ranged from 160-168 centimetres and weight ranged from 54-64 kilograms were in summer coaching camp conducted by Sports Development Authority of Tamil Nadu, Thanjavur Unit, India. Static Stability and Dynamic movement testing were conducted for 4 experimental groups. To achieve the purpose of the study testing is to determining the Individuals ability to stabilise the Torso and control the body. In many cases the larger and stronger muscles will cover-up or hide weakness in the smaller stabilising muscles. It is extremely important that the muscles of postural support are strong enough to with stand the stress of explosive training* ***(Albert 1991).*** *The basic static test are followed in static stability testing difficulty can be increased by having participants being tested close their eyes for 30 seconds prior to the initiation of a plyometric program. The study was concluded the training can be favourable for the selected variables in this study.*

Key Words*--Resistance Training, DynamicMovement, Stronger Muscles, Static Stability, Plyometric Program*

I. INTRODUCTION

Resistance training is a potent stimulus to the neuromuscular system depending on the specific designed program. Resistance training can enhance strength, power, or local muscular endurance, improvements in performance directly related to the physiologic adaptations elicited through prolonged duration

[1]Associate Professor, Alagappa University College of Physical Education, Alagappa University, Karaikudi. Tamil Nadu, India.
[2]Ph.D Research Scholar, Alagappa University College of Physical Education, Alagappa University, Karaikudi, Tamil Nadu, India.
[3]Ph.D Research Scholar, Alagappa University College of Physical Education, Alagappa University, Karaikudi, Tamil Nadu, India.

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of practices. Optimal resistance training programs are individualized to meet specific training goals. When trained properly, similar intensity and volume these functional and physiologic adaptations are similarly impressive among women and the aged as they are among young men. **Deschenes (2006).,** In contrast to relative measurements, sex and age differences exist in the absolute magnitude of adaptations of equal importance, perhaps most notably among the elderly, are the important health benefits that may also be derived from resistance training. e.g, bone density, insulin sensitivity, and co-morbidities associated with obesity can be effectively managed with resistance exercise when it is conducted on a regular basis. The extent of the functional and health benefits to be occurred from resistance training depends on factors such as initial performance and health status, along with the specification of program designed variables such as frequency, duration, intensity, volume, and rest intervals.

Objectives

a. To find out the relative effect of isolated combined and complex resistance training on selected strength parameters.

b. To find out the relative effect of isolated combined and complex resistance training on selected speed parameters.

c. To find out the relative effect of isolated combined and complex resistance training on selected power parameters.

Hypothesis

a. It was hypothesized that there would be a significant improvement on Strength, Speed and Power due to isolated weight training.

b. It was hypothesized that there would be a significant improvement on Strength, Speed and Power due to isolated Plyometric training.

c. It was hypothesized that there would be a significant improvement on strength, speed and Power due to combined effect of weight training and plyometric training.

d. It was hypothesized that there would be a significant improvement on strength, speed and Power due to Complex Resistance training.

II. METHODOLOGY

Selection of the subjects

The purpose of the study was to analyse the relative effect of isolated combined and complex resistance training on selected strength, speed and power parameters among College Men Students. To achieve the purpose of the study, from the population of 40 College Men students those who have participated and their age of the subjects ranged from 16 to 19 years, height ranged from 160-168 centimetres and weight ranged from 54-64 kilograms were in summer coaching camp conducted by Sports Development Authority of Tamil Nadu, Thanjavur Unit, India. Static Stability and Dynamic movement testing were conducted for 4 experimental groups. To achieve the purpose of the study testing is to determining the Individuals ability to stabilise the Torso and control the body. In many cases the

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larger and stronger muscles will cover-up or hide weakness in the smaller stabilising muscles. It is extremely important that the muscles of postural support are strong enough to with stand the stress of explosive training **(Albert 1991).** The basic static test are followed in static stability testing difficulty can be increased by having participants being tested close their eyes for 30 seconds prior to the initiation of a plyometric program.

Selection of Variables

Strength, speed and power are all specific to demands and their improvement depends upon the sports performance, for that purpose the following dependent variables were selected for this study such as, Leg strength, Back strength, Speed and Explosive power tested prior to Plyometric static testing.

Table 1: Plyometric Static Stability Testing

S.NO	Name of test items	Duration
1	Single leg stance, Eyes open and Eyes closed	30 seconds
2	Single leg quarter squat, Eyes open and Eyes closed	30 seconds
3	Single leg half squat, Eyes open and Eyes closed	30 seconds

Selection of tests

The Experimental groups were required to perform three sessions per week on alternate daysi.e. on Monday, Wednesday and Friday for 12 weeks. Thus, the programme entitle 36 training workouts sessions. However, the duration of each training session is 90 minutes, same for 4 groups and their training begun with a standardised warm up routine consisting of running, calisthenics and stretching was used. Before the initiation of the training programmes, the participants of all groups were instructed about the execution of the exercises and safety precautions to awake injury. The training protocol included upper body, lower body and trunk exercises. The selection of exercises employed in experimental groups namely, isolated weight training, Plyometric training and combined weight and plyometric training and complex resistance training shown in table II.

Table 2: Selection Of Exercise For Weight Training Groups

Name of Exercises	Phase I *& 11*	Phase 111* IV*
lower body	Front squat	Back squat
	Forward lunges	Split squat
	Barbell seated calf raise	Quarter squat
	Leg extension	Step ups
	Dead lift	Power clean
Upper body	Shoulder press	Bench press
	Barbell upright row	Shoulder shrug
Trunk	Bent knee sit ups	Hip press up
	Crunch with support	Knee pull in

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A phase consists of three weeks duration

In creating the isolated weight training programme, adhered to the principle that load during Phase I and II 80% of the maximum and 90% during the Phase III and IV from an average of 1RM. The participants in the weight training group stated with three sets of 8 repetitions during Phase I and II, and progressed with three sets of high 5 repetition during Phase III and IV at 80% and 90% of the maximum from average of 1RM. In plyometric training the volume is often measured by counting of foot contact progressive overload principles were incorporated into the programme by increasing the intensity of exercise or Number of Foot Contacts. The Number of sets and foot contact in each drill was designed according to the intensity of exercise. The Plyometric training group perform a total number of 291low load foot contact for Phase I & II and 260 High Load foot contact Phase III & IV, It is similar for Combined and complex resistance training group. The Combined training group perform weight training exercises solely on Phase I for three weeks and plyometric exercises solely on Phase II for three weeks; same were followed in Phase III and Phase IV. The Complex group competed both weight training and plyometric training exercises, set for set on the sameTraining sessions as shown in Table III**.**

Table 3: Selection Of Exercise For Plyometric Training Groups

Name of Exercises	**Phase I *& 11***	**Phase 111* &IV***
lower body	Front barrier hop	Depth jump
	Split squat jump	Bounding with single arm
	Two-foot ankle hop	Rim jump
	Straight pike jump	Single leg push-off
	Double leg hop with barriers	Jump to box
Upper body	Vertical toss	Clap push up
	Backward throw with jump to box	Underhand throw
Trunk	Pull over pass	Leg toss
	Sit ups throw	Sit ups throw

*A phase consists of three weeks duration

Recovery between sets lasted 3 to 4 minutes for the next exercises for weight training group, recovery for a plyometric training groups is 3 to 4 minutes between sets and 5 to 10 seconds for repetitions involved high load exercise like depth jump . The combined weight training and Plyometric training group followed the above mentioned recovery time for their respective groups. Complex resistance training group perform both weight training and plyometric training programme, set for set in the same training sessions. In this Phase participants complete a set of weight training exercises, after recovery of 3 to 4 minutes and then perform a set of biomechanically similar plyometric exercises. There would be recovery of 3 to 5 minutes for the next set of period of exercises. There was always a rest window of 48 hours between two training sessions. All training sessions were observed to ensure the quality of the workout as shown in table IV.

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Table 4: Selection Of Exercise For Combined Weight And Plyometric TrainingGroups

Exercises	Phase I*	Phase II*	Phase III*	Phase IV*
lower body	Front squat	Front barrier hop	Back squat	Depth jump
	Forward lunges	Split squat jump	Split squat	Bounding with single arm
	Barbell seated calf raise	Two-foot ankle hop	Quarter squat	Rim jump
	Leg extension	Straight pike jump	Step ups	Single leg push-off
	Dead lift	Double leg hop with barriers	Power clean	Jump to box
Upper body	Shoulder press	Vertical toss	Bench press	Clap push up
	Barbell upright row	Backward throw with jump to box	Shoulder shrug	Underhand throw
Trunk	Bent knee sit ups	Pull over pass	Hip press up	Leg toss
	Crunch with support	Sit ups throw	Knee pull in	Sit ups throw

Experimental Design

The experimental design used in this study was pre test and post test random group design. The selected subjects were divided at random into 4 experimental groupsof ten each**.** The basic static test are followed in static stability testing difficulty can be increased by having participants being tested close their eyes for 30 seconds prior to the initiation of a plyometric program. The selected participants were randomly assigned into four groups of ten participants each (n=10). Group I underwent weight training (WT), group II underwent plyometric training(PT), group III underwent combined training (WPT) (weight and plyometric training) and group IV underwent complex resistance training (C*T).

Statistical technique

The data collected from the four groups prior to and post experimental on selected dependent variables: leg strength, back strength, speed and explosive power (vertical) were statistically analysed by ANCOVA. Whenever the 'F' ratio for adjusted post test means was found to be significant, scheffe's test was followed as a post hoc test to determine which of the paired means difference was significant. In all the cases 0.05 level of confidence was fixed at a level of confidences to test the hypotheses.

III. ANALYSIS ON FINDINGS

Leg Strength and Back Strengthtest Were in Significant. Shows in the Table I And II Respectively

A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and dependent variable did not differ significantly as a function of the independent variable, 'F' ratio (3,32) = 1.36, p> 0.272 (See Table IV). The ANCOVA 'F' ratio was not significant for df (3, 35) = 0.277, p >0.05 (See Table IV). However, only 3% (ω^2 = 0.03) of the total variance in leg strength was accounted for by the four training groups for the effect of a Leg Lift with dynamometer test were presented in Figure 1. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and dependent variable did not differ significantly as a function of the independent variable, 'F' ratio (3,32) 0.430, p > 0.733(See Table V). The ANCOVA 'F' ratio was not significant for df (3, 35) = 1.215, p >0.05 (See Table V). However, only 1% (ω^2 =

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0.01) of the total variance in back strength were accounted for by the four training groups for the effect of Back Lift with dynamometer test were presented in Figure II.

Table 5: Analysis of Co Variance Computed for Weight Training Plyometric Training Combined Training and Complex Resistance Training Group for Leg Strength

Source	SS	df	MS	F	P	ω^2
Groups	0.739	3	0.246	0.277	0.841	0.03
Error	31.088	35	0.888			

Table value required for significance at 0.05 level of 3 & 35 was 2.874.

Table 6: Analysis Of Co Variance Computed For Weight Training Plyometric Training Combined Training And Complex Resistance Training Group For Back Strength

Source	SS	df	MS	F	P	ω^2
Groups	3.133	3	1.044	1.215	0.319	0.01
Error	30.093	35	0.860			

Table value required for significance at 0.05 level of 3 & 35 was 2.874

Speed And Explosive Power(Vertical) Tests Were Significant. ShowsIn The Table No VI, VI aAndVII, VII a Respectively

A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and dependent variable did not differ significantly as a function of the independent variable, 'F' ratio (3,32) = 2.67, p > 0.064 (See Table VI). The ANCOVA 'F' ratio was significant for df (3, 35) = 33.75, p <0.05 (See Table VI). However, only 65% (ω^2 = 0.65) of the total variance in speed was accounted for by the four training groups for the effect of 50 meters run test. In order to find out which of the paired means significantly differ scheffe's post hoc test is applied and effect size were present in the (See Table VI a) for four training groups. The scheffe's procedure was used to control for Type I error across the six pairwise comparisons (a .05/6 0.16). The results showed that complex training group (M = 6.633) had significantly better than the combined training group (M = 6.877), plyometric training group (M = 7.055) and weight training group (M 7.125). . The effect size of those significant adjusted mean differences with combined training group and weight training group, combined training group and plyometric training group were 2.10 and 1.50 respectively. The effect size of those significant adjusted mean differences with complex training group and weight training group, complex training group and plyometric training group, complex training group and combined training group were 4.16, 3.57 and 2.06 respectively. Test were presented in Figure III. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of independent variable, 'F' ratio (3,32) 2.43, p> 0.084 (See Table VII). The ANCOVA 'F' ratio was significant for df(3, 35) 41.18, p <0.05 (See Table IX). However, only 45% (u2 = 0.45) of the total variance in explosive power (vertical) was accounted for by the four training groups for the effect of sargent jump test. In order to find out which of the paired means significantly different scheffe's post hoc test is applied and effect size were present in the (See Table VII a) for four training groups. Follow-up was conducted to evaluate pairwise differences among the adjusted means for experimental groups. The scheffe's procedure was used to control for Type I error across the six pairwise comparison (a = .05/6 1.68). The results showed that complex training group (M 53.375) had significantly better than the combined training group (M = 52.175), plyometric training group (M 49.175) and

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weight training group (M = 47.775). The effect size of those significant adjusted mean differences with combined training group and weight training group, combined training group and plyometric training group were 3.44 and 2.35 respectively. The effect size of those significant adjusted mean differences with complex training group and weight training group, complex training group and plyometric training groups were 4.38 and 3.29 respectively. Tests were presented in Figure IV.

Table 7: Analysis of Covariance Computed for Weight Training Plyometric Training Combined Training and Complex Resistance Training Group for Speed

Source	SS	df	MS	F	P	ω^2
Groups	1.441	3	0.480	33.75*	.000	0.65
Error	0.498	35	0.014			

*Significant at 0.05 level of confidence

Table value required for significance at 0.05 level of 3 & 35 was 2.874

Table 8: Scheffe'sPost Hoc Paired Means Comparisons and Effect Size on Speed of Experimental Groups

Group	Adjusted mean	Adjusted mean differences (Effect size are indicated in parentheses)			
		1	2	3	4
Weight	7.125	---			
Plyometric	7.055	0.070			
Combined	6.877	0.248* (2.10)	0.178* (1.50)		
Complex	6.633	0.492* (4.16)	0.422* (3.57)	0.244* (2.06)	

*Significant at 0.05 level of confidence Scheffe's C.I value 0.16;

Table 9: Analysis of covariance computed for weight training plyometric training combined training and complex resistance training group for explosive power (vertical)

Source	SS	df	MS	F	P	ω^2
Groups	201.892	3	67.297	41.18*	.000	0.45
Error	57.200	35	1.634			

*significant at 0.05 level of confidence

Table value required for significance at 0.05 level of 3 & 35 was 2.874

Table 10 :scheffe's post hoc paired means comparisons and Effect size on explosive power (vertical) of Experimental groups

Group	Adjusted mean	Adjusted mean differences (Effect size are indicated in parentheses)			
		1	2	3	4
Weight	47.775	---			
Plyometric	49.175	1.400	---		
Combined	52.175	4.400* (3.44)	3.000* (2.35)	---	
Complex	53 .375	5.600* (4.38)	4.200* (3.29)	1.200	---

*Significant at 0.05 level of confidence Scheffe's C.I value 1.68;

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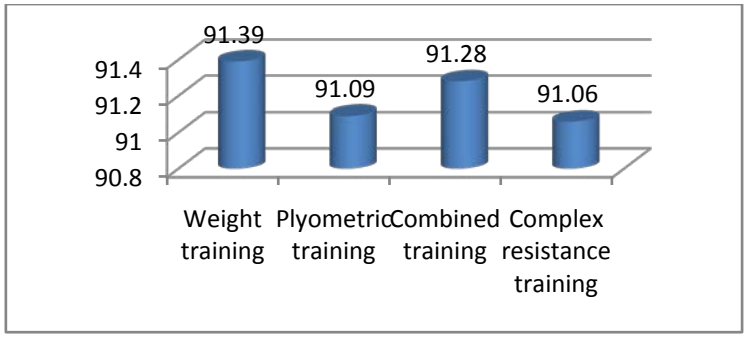

Figure 1: Analysis of co variance computed for weight training plyometric training combined training and complex resistance training group for leg strength

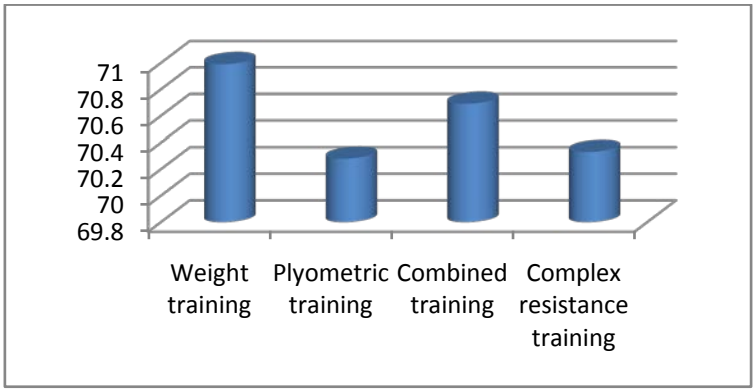

Figure II: Analysis of Co Variance Computed for Weight Training Plyometric Training Combined Training and Complex Resistance Training Group For Back Strength

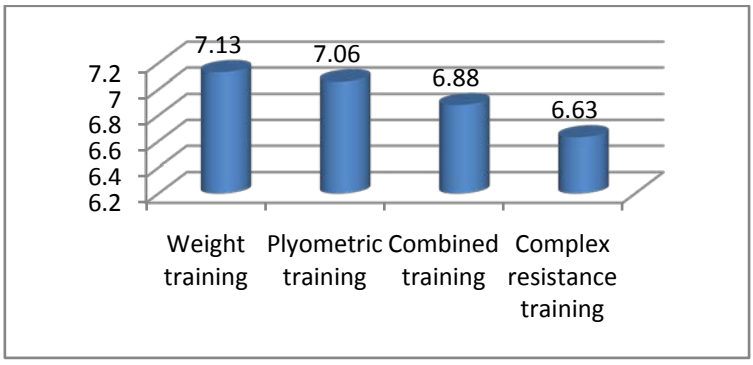

Figure III: Analysis of Covariance Computed for Weight Training Plyometric Training Combined Training and Complex Resistance Training Group for Speed

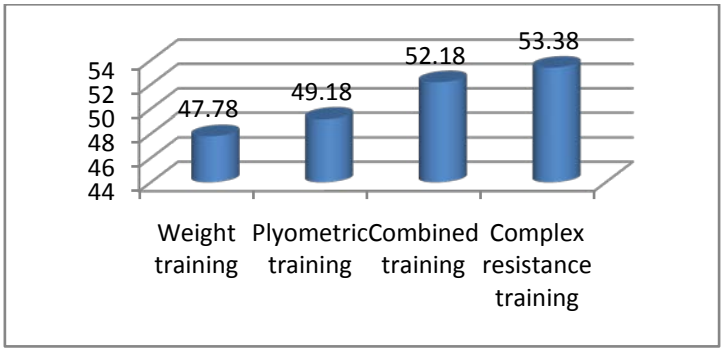

Figure IV: Analysis of Covariance Computed for Weight Training Plyometric Training Combined Training and Complex Resistance Training Group for Explosive Power (Vertical)

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IV. DISCUSSION ON FINDINGS

The weight training group in improving arm strength and leg strength **sundaramoorthy, (1991).Azeem and Ameer, (2010)** revealed that weight training improve strength and also sshowed some improvement in speed and flexibility. In general, heavy strength training on leg extensor muscles is reported to improve power, jumping height, and sprint performance. Consequently, a wide variety of strength training modes and training protocols have been used to develop lower extremity strength and power (**Fatouros, I.J, et al., 2000).**

Rahimi, R., and Behpur, N, (2005) indicate that short term plyometric training is capable of improving the vertical jumping ability. The plyometric exercises in the training program for the experimental group led to an improvement in physical abilities and skilful performance of the basketball players **(Shallby, H. K, 2010).** Plyometric exercises can be done with or without external load, and both modalities have been shown to increase power, jumping height, and sprint performance **(McBride, J. M, et al., 2002).**

The combined training group showed signs of improvement in the angular velocity that was significantly greater than the improvement of the other two training group plyometric training and weight training (**Rahimi, R., Arshadi, P.,** weight and plyometric training group improving explosive strength, strength endurance, speed and elastic power **(SUNDARAMOORTHY, 1999).**

Complex training may help improve performance in sprint cycling that requires angular velocity, angular acceleration and power **(Rahimi, R., Arshadi, P., Behpur, N., Boroujerdi S., S., &Rahimi, M. 2006).** The complex training group demonstrated significant improvement in vertical jump (2.8 cm) compared to the non-complex training group (0.1cm) **Burger et al., (2000).** The finding suggest by **Mihalik, J, P et al., (2008)** shows that three weeks of both complex and compound training significantly improve vertical jumping height (VJH). In which, the complex training group improved VJH by; 5% while the compound training group improved VJH by; 9% and 5% increase in the complex group represented a mean increase of 2.7cm; the 9% increase in the compound training group represented a mean increase 4.77cm. although no statistically significant differences were observed between the two training groups.

V. CONCLUSIONS

Based on the results of the present study the following conclusions have been school boys.

1. The experimental groups namely isolated weight training, plyometric training, combined (weight and plyometric) training and complex resistance training groups had significant difference towards improving the participants speed and explosive power (vertical)
2. The experimental groups namely isolated weight training, plyometric training, combined (weight and plyometric) training and complex resistance training groups had significant difference towards improving the participants leg strength and back strength.
3. There were significant difference towards improving the participants improvement of isolated weight training group participants in leg strength, back strength, speed and explosive power (vertical).
4. Complex resistance training out performed than the combined (weight and plyometric) training and plyometric training on speed and explosive power (vertical).

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5. Isolated weight training out performed than the complex resistance training, combined (weight and plyometric) training and plyometric training on leg strength and back strength.

VI.RECOMMENDATIONS

In the light of the experience gained from the present study, a few suggestions are made for future study. In the course of the study the investigator faced several problems for which no sufficient answers were found in the literature. These problems are therefore stated below for future study.

1. The same study may be conducted on some other groups of players.

2. The same study may be analyzed with some other variables for another group.

3. The study may be recommended for various level players.

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