

# Comparative Effect of Plyometric Training and Resistance Training on Selected Fitness Variables among National Level Female Basketball Players

## Abstract

A total of forty five female (N=45) School National level female basketball players ranging between 16-18 years of age were taken as subjects for the purpose of the study. The subjects were randomly selected and training was conducted at Government Senior Secondary Girls School, Mall Road, Amritsar. The subjects were divided into two groups namely: Experimental Group (30 subjects in total) and Control Group (15 subjects). The Experimental group was further sub-divided into two groups of 15 subjects in each group. Experimental Group-I was given Plyometric Training, Experimental Group-II as Resistance Training. The fitness variables were selected for the purpose of the study: flexibility test (sit and reach test), strength test (vertical jump test), speed test (50m dash test), agility (shuttle run test) and cardio-vascular fitness test (cooper 12 minute run-walk test). In order to find out the differential effects of the two treatment groups and one control group, ANCOVA test was computed with the help of SPSS computer software. The LSD post-hoc test was applied in cases where 'F'-ratio has shown significance to find out which of the differences of the paired means were significant. The level of significance chosen was 0.05. Result shows that Resistance group demonstrated maximum effect on the flexibility with improved performance in sit and reach than other groups. Both the groups namely Plyometric and Resistance group improved their explosive leg strength significantly than control group. Plyometric group showed maximum increment performance in 50m dash as compared to resistance group, combined group and control group. It is clear from the results that Plyometric group was the best effective treatment group to improve endurance level followed by Resistance group improved the endurance as compared to control group.

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**Introduction**

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Speed and strength are integral components of fitness found in varying degrees in virtually all athletic movements. Simply put the combination of speed and strength is power. For many years, coaches and athletes have sought to improve power in order to enhance performance. Throughout this century and no doubt long before, jumping, bounding and hopping exercises have been used in various ways to enhance athletic performance. In recent years, this distinct method of training for power or explosiveness has been termed plyometrics. In the field of training there is a new techniques emerged similar to the nature of performance basketball skills by developing the ability fitness by means of plyometric training. The importance of this study lies in demonstrating an important aspect of special preparation and training for the competition as through the matches the matter that enables the author to determine the problems of that study as a scientific attempt directed to study that effect of using the plyometric training on developing the physical fitness abilities of the basketball players.

In the field of training there is a new techniques emerged similar to the nature of performance basketball skills by developing the ability fitness by means of plyometric training. The main goal of plyometric training is to transform the energy that depends on the flexibility resulted from the body and gravity throughout muscles contraction by stretching to an equivalent force in quantities and contrary in the direction throughout muscle contraction by shortening. The plyometric training affects both the muscle and nervous system. The importance of this study lies in demonstrating an important aspect of special preparation and training for the competition as

through the matches the matter that enables the author to determine the problems of that study as a scientific attempt directed to study that effect of using the plyometric training on developing the physical fitness abilities of the basketball players. The training process in professional sport is possible only if it is based on systematic testing of the player's physical fitness and motor abilities. The training of player's physical fitness should focus on developing special abilities to ensure effective competition. Basketball is a discipline dominated by high and maximum intensity efforts based on anaerobic processes. The training of player's physical fitness should focus on developing special abilities to ensure effective competition. Basketball is a discipline dominated by high and maximum intensity efforts based on anaerobic processes.

Resistance training programme can improve measures of strength and power in adults (Chu, 1998; Fleck and Kraemer, 2004). In children and adolescents, it is well-established that training-induced gains in strength and power are indeed possible following participation in a resistance training programme (Faigenbaum et al., 1996; Falk and Tenenbaum, 1996). Resistance training during a training cycle should be structured to allow maximal efficacy and physical improvement. Since young athletes are often encouraged to perform static stretching prior to resistance exercise (Martens, 2004). Resistance training is "the ideal counterpart to plyometric training." A number of sources describe the combination of weight training and plyometric training without calling it complex training. Resistance training has been used extensively to increase fitness and sport performance. It has been demonstrated to augment maximum strength, power, and jumping ability. It is well known that a variety of resistance training programs can stimulate an increase in one repetition maximum strength. However, only few studies have attempted to make direct comparisons of different styles of resistance training programs to determine adaptation differences.

It is important to ascertain the most efficacious method for enhancing fitness performance in children and adolescents. This information would be useful to physical educators, sport coaches and health care providers. Abdel (1999) conducted a study aimed to identify the effect of a training program of muscles fitness and power fitness on the growth rates of physical qualities and basic skills of basketball on a sample of 17 players under the age of 17 years old. The author used the experimental method where the most important results were that the proposed training program led to the development of the muscles fitness and power fitness and improvement of the basic skills of basketball. Therefore, the purpose of the present investigation was to compare the effects of 8-week training period of plyometric and resistance with fitness in youth Basketball players.

**Procedure and Method:**

The present study was conducted on forty five (45) School National level female basketball players ranging between 16-18 years of age. The

subjects were randomly selected and training was conducted at Government Senior Secondary Girls School, Mall Road, Amritsar (Punjab). The subjects were divided into two groups namely: Experimental Group (30 subjects in total) and Control Group (15 subjects). The Experimental group was further subdivided into two groups of 15 subjects in each group. Experimental Group-I was given (Plyometric Training), Experimental Group-II (Resistance Training). All the subjects were local residents. Measurements for variables were taken at the beginning (pre-test) and at the end of experimental training period after eight weeks (post-test). During data collection period, the subjects were not allowed to participate in any competition except daily training schedule. The following variables were selected for the purpose of the study: Flexibility test (sit and reach test), strength test (vertical jump test), speed test (50m dash test), agility (shuttle run test) and cardio-vascular fitness test (cooper 12 minute run-walk test).

In order to find out the differential effects of the two treatment groups (Plyometric and Resistance) and one control group, Analysis of Covariance (ANCOVA) was computed with the help of SPSS computer software. The LSD post-hoc test was applied in cases where 'F'-ratio has shown significance to find out which of the differences of the paired means were significant. The level of significance chosen was .05.

**Data Analysis and Results:**

The ANCOVA for different Training groups (Experimental group-1: Plyometric group, Experimental group-2: Resistance group and control group of school national level female basketball players for fitness variables comprising of sit and reach is presented below. For the variables, the statistical analysis revealed resultant 'F' value of 0.240 was not significant at 0.05 level. This indicates that all the groups had shown significant difference in their initial means. The post test means of 2.46 for Plyometric group, 2.09 for Resistance group and 2.08 for control group were recorded and resultant 'F' value of 2.38 which was also not significant at 0.05 level. The adjusted final means were 2.37, 2.09 and 2.16 for Plyometric, Resistance and control group respectively, yielded 'F' value of 4.07, which was statistically significant at 0.05 level. The data pertaining to this has been presented in Table-1.

**Table-1**  
**ANCOVA on Sit & Reach of School National Level Female Basketball Players**

Tests	Groups (Mean)			Source of Variance	Sum of Square	Df	Mean Square	'F' Value
	Exp Gp-1	Exp Gp-2	Cont Gp.					
Pre-Test Means	2.19	2.05	1.94	Between Groups	.462	3	.154	0.240
				Within Groups	35.89	56	.641	
Post-Test Means	2.46	2.09	2.08	Between Groups	4.67	3	1.56	2.38
				Within Groups	36.68	56	.655	
Adjusted Final Mean	2.37	2.09	2.16	Between Groups	4.07	3	1.34	4.07*
				Within Groups	18.23	55	.331	

\*Significant at 0.05 level 'F' <sub>0.05 (2, 40)</sub> = 3.23

Since, 'F' value (ANCOVA) for adjusted mean were found significant, LSD post-hoc test was applied to find out, which of the mean difference between the paired adjusted means were significant. The data pertaining to this has been presented in Table-2.

**Table-2**  
**Significant Differences between the Paired Adjusted Final Means of Sit and Reach Fitness Variable among Different Training Groups**

Fitness Variables	Groups (mean)			M.D
	Exp. Gp-1	Exp. Gp-2	Cont. Gp.	
Sit And Reach	2.37	2.09		.278
	2.37		2.16	.203
		2.09	2.16	.075

\*Significant at .05 level  
 $I_{.05}(2, 40) = 0.60$

From the description presented in table-2, it has been found that there was no significant difference in the adjusted means between Plyometric and Resistance group, plyometric and control group, resistance and control group as .278, .203 and .075 values were found smaller than the critical ratio ( $I=0.60$ ).

The Analysis of Covariance for different Training groups and control group of school national level female basketball players for fitness variables comprising of vertical jump is presented in table-3.

**Table-3**  
**ANCOVA on Vertical Jump of School National Level Female Basketball Players**

Test	Groups (Mean)			Source Of Variance	Sum of Square	Df	Mean Square	'F' Value
	Exp Gp-1	Exp Gp-2	Cont Gp.					
Pre-Test Means	6.95	8.53	6.18	Between Groups	48.72	3	16.24	8.27*
				Within Groups	49.76	56	.889	
Post-Test Means	8.00	9.23	6.32	Between Groups	84.83	3	28.28	30.37*
				Within Groups	52.15	56	.931	
Adj. Final Mean	8.41	8.22	7.42	Between Groups	10.89	3	3.63	16.94*
				Within Groups	11.78	55	.214	

\*Significant at 0.05 level  
 $F'_{0.05}(2, 40) = 3.23$

The above table indicate that there has been a significant difference among pre-test and post-test mean scores of various training groups of school national level female basketball players among fitness variables comprising of vertical jump as the obtained 'F' values (pre-test : 18.27 and post-test : 30.37) were found to be greater than the table value of 3.23, which is required to be significant at 0.05 level of significance. Further, the results of adjusted final

means indicated significant difference among four groups at 0.05 level as obtained 'F' value 16.94 was much more than the table value of 3.23. It is clear from the results that there was meaningful effect of experimental treatment on the groups as the 'F' value is higher than the table value. LSD post-hoc test of significance was applied to find the actual effect of Experimental treatment on the groups. The results have been presented below.

**Table-4**  
**Significant Differences between the Paired Adjusted Final Means of Vertical Jump Fitness Variable among Different Training Groups**

Fitness Variables	Groups (Mean)			Md
	Exp. Gp-1	Exp. Gp-2	Cont. Gp.	
Vertical Jump	8.41	8.22		.190
	8.41		7.42	.990*
		8.22	7.42	.800*

\*Significant at .05 level  
 $I_{.05}(2, 40) = 0.48$

The results in table-4 show that the mean difference between adjusted paired means was statistically significant in Plyometric and resistance in comparison to control group at 0.05 levels as final adjusted means of .990, .800 were found greater than the critical ratio ( $I=0.48$ ). However the mean differences between the remaining groups when compared to each other were not found significant. The Analysis of Covariance for different Training groups and control group of school national level female basketball Players for fitness variables comprising of 50m dash is presented in table-5.

**Table-5**  
**ANCOVA on 50 M Dash of School National Level Female Basketball Players**

Tests	Groups (Mean)			Source Of Variance	Sum of Square	Df	Mean Square	'F' Value
	Exp Gp-1	Exp Gp-2	Cont Gp.					
Pre-Test Means	8.97	8.97	8.85	Between Groups	.144	3	.048	.256
				Within Groups	10.52	56	.188	
Post-Test Means	8.25	8.57	8.61	Between Groups	1.15	3	.382	2.305
				Within Groups	9.29	56	.166	
Adj. Final Mean	8.22	8.54	8.67	Between Groups	1.617	3	.539	13.21*
				Within Groups	2.245	55	.041	

\*Significant at 0.05 level  
 $F'_{0.05}(2, 40) = 3.23$

Table-5 indicated that pre-test means for plyometric group, resistance group and control group were 8.97, 8.97, 8.92 and 8.85 respectively. The resultant 'F' value of .256 was not significant at 0.05 level. This indicates that all the groups had shown

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significant difference in their initial means. The post-test means of 8.25 for plyometric group, 8.57 for resistance group and 8.61 for control group were recorded and resultant 'F' value of 2.305 which was also not significant at 0.05 level. The adjusted final means were 8.22, 8.54 and 8.67 for plyometric, resistance and control group respectively, yielded 'F' value of 13.21, which was statistically significant at 0.05 level. Since, 'F' value (ANCOVA) for adjusted mean were found significant, LSD post-hoc test was applied to find out, which of the mean difference between the paired adjusted means were significant. The data pertaining to this has been presented in table-6.

**Table-6**  
**Significant Differences between the Paired Adjusted Final Means of 50 M Dash Fitness Variable among Different Training Groups**

Fitness Variables	Groups (Mean)				Md
	Exp. Gp-1	Exp. Gp-2	Exp. Gp-3	Cont. Gp.	
50 M Dash	8.22	8.54			.315*
	8.22			8.67	.452*
		8.54		8.67	.137

**\*Significant at .05 level**

$$I_{.05}(2, 40) = 0.21$$

The result in table-6 show that the mean differences between adjusted paired means were statistically significant in all the groups at 0.05 level, except between resistance group and control group as the mean difference were higher than the critical ratio (I=0.21). It is clear that in case of plyometric group, 50m dash has most significantly effected as compared to resistance group and control group. The ANCOVA for different training groups and control group of school national level female basketball players for shuttle run is presented in table-7.

**Table-7**  
**ANCOVA on Shuttle Run of School National Level Female Basketball Players**

Tests	Groups (Mean)			Source of Variance	Sum of Square	Df	Mean Square	'F' Value
	Exp Gp-1	Exp Gp-2	Cont Gp.					
Pre-Test Means	11.95	11.90	11.92	Between Groups	.051	3	.017	.080
				Within Groups	11.90	56	.213	
Post-Test Means	11.44	11.15	11.59	Between Groups	5.06	3	1.69	5.85*
				Within Groups	16.16	56	.289	
Adj. Final Mean	11.41	11.16	11.58	Between Groups	4.276	3	1.425	13.83*
				Within Groups	5.668	55	.103	

**\*Significant at 0.05 level**

$$F'_{0.05}(2, 40) = 3.23$$

The above results indicate that there has been a significant difference among post-test mean scores of various training groups of school national level female basketball players among fitness variables comprising of shuttle run as the obtained 'F' value (post-test: 5.85) was found to be greater than the table value of 3.23, which is required to be significant at 0.05 level of significance. Further, the results of adjusted final means indicated significant difference among four groups at 0.05 level as obtained 'F' value 13.83 was much more than the table value of 3.23. It is clear from the results that there was meaningful effect of experimental treatment on the groups as the 'F' value is higher than the table value. Therefore, LSD post-hoc test of significance was applied to find the actual effect of Experimental treatment on the groups. The results have been presented in table- 8.

**Table-8:**  
**Paired Adjusted Final Means of Shuttle Run Fitness Variable Among Different Training Groups**

Fitness Variables	Groups (Mean)				Md
	Exp. Gp-1	Exp. Gp-2	Exp. Gp-3	Cont. Gp.	
Shuttle Run	11.41	11.16			.246*
	11.41			11.58	.174
		11.16		11.58	.420*

**\*Significant at .05 level**

$$I_{.05}(2, 40) = 0.24$$

It is observed from table-8 that the mean differences between adjusted means were statistically significant in all the groups at 0.05 level of significance, except between Plyometric group and Control group as the mean difference was higher than the critical ratio (I=0.24). The ANCOVA for different training groups and control group of school national level female basketball players for shuttle run is presented in table-9.

**Table-9**  
**ANCOVA on Cooper 12 Min. Run Walk of School National Level Basketball Players**

Tests	Groups (Mean)			Source Of Variance	Sum Of Square	Df	Mean Square	'F' Value
	Exp Gp-1	Exp Gp-2	Cont Gp.					
Pre-Test Means	1902.7	1857.3	1806.7	Between Groups	69626.7	3	23208.9	.653
				Within Groups	1990613.3	56	35546.7	
Post-Test Means	1990.0	2012.7	1820.7	Between Groups	805605	3	268535	6.19*
				Within Groups	2428120	56	43359.3	
Adj. Final Mean	1938.6	2009.1	1870.7	Between Groups	649383.4	3	216461.1	8.05*
				Within Groups	205106.2	55	3729.2	

**\*Significant at 0.05 level**

$$F'_{0.05}(2, 40) = 3.23$$

The above table indicates that there has been a significant difference among post-test mean scores of various training groups of school national level female basketball players among fitness variables comprising of cooper 12 min run walk as the obtained 'F' value (Post-test: 6.19) was found to be greater than the table value of 3.23, which is required to be significant at 0.05 level of significance. Further, the results of adjusted final means indicated significant difference among three groups at 0.05 level as obtained 'F' value 58.05 was much more than the table value of 3.23. It is clear from the results that there was meaningful effect of experimental treatment on the groups as the 'F' value is higher than the table value. Therefore, LSD post-hoc test of significance was applied to find the actual effect of Experimental treatment on the groups. The results have been presented in table- 10.

**Table-10**

**Significant Differences between the Paired Adjusted Final Means of Cooper 12 Min Run Walk Fitness Variable among Different Training Groups**

Fitness Variables	Groups (Mean)				Md
	Exp. Gp-1	Exp. Gp-2	Exp. Gp-3	Cont. Gp.	
Cooper 12 Min. Run Walk	938.57	2009.14			70.57*
	938.57			870.69	67.88*
		2009.14		870.69	138.46*

**\*Significant at .05 level**

$F_{.05}(2, 40) = 64.28$

It is observed from table- 10 that the mean differences between adjusted-paired means were statistically significant in all the groups at 0.05 level of significance as the adjusted mean differences of all three groups was higher than the critical ratio ( $F=64.28$ ). All the three experimental groups showed significant improvement in 12 cooper run walk test as compared to control group.

**Conclusion**

From the above analysis, it revealed that resistance group demonstrated maximum effect on the flexibility with improved performance in sit and reach than other groups. Both the groups namely plyometric and resistance group improved their explosive leg strength significantly than control group. Plyometric group showed maximum increment performance in 50m dash as compared to resistance group, combined group and control group. Plyometric and Resistance group also improved the shuttle run timing significantly as compared to the control group. It is clear from the results that Plyometric group was the best effective treatment group to improve endurance level followed by Resistance group improved the endurance as compared to control group.

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