

## **Effect of Plyometric and Circuit Training on Selected Physical Fitness Variables on School Children**

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### **Abstract**

The term 'Training' has remained a part of human language since ancient times, which indicates preparation of beginning any work. The term 'Plyometric' was derived from Latin language, which means 'more tough and burly'. Circuit training is very important for development of elements necessary for muscular fitness. The purpose of the study was to see the effect of Plyometric and Circuit Training on Selected Physical Variables on school children. In order to draw an adequate representative sample, 150 boys from the 03 Schools Vasnda, Dist. Navsari were selected with age ranging between 14 to 16 years. Further they were divided into 3 groups of 50 each. The pretest of aspects of physical fitness was conducted on each group. Then, Group A was provided plyometric training and group-B, circuit training for 12 weeks. Group – C was accepted as the control group. Finally, the posttest was executed on all three groups. To test the effect of training on physical fitness following test were included for the present study i.e. Pull Ups, Bent Knee Sit Ups, 50 Yard Dash, Standing Broad Jump and Shuttle Run. It was concluded that due to Plyometric and Circuit training, significant improvement was seen in the performance of subjects upon comparison to the Control Group.

**KEYWORDS :** Plyometric, Circuit, Training, Physical Fitness.

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### **INTRODUCTION**

The term 'Training' has remained a part of human language since ancient times, which indicates preparation of beginning any work. The term 'Plyometric' was derived from Latin language, which means 'more tough and burly'. It was believed that aim of plyometric was to provide exercise to athletes. Power is produced by joining force with speed while doing movement. In plyometric training, the important thing was that the player jumped, lifted or threw. Circuit training is very important for development of elements necessary for muscular fitness. Weight lifting exercises, other obstructive exercises, calisthenics, race, swimming or stretching exercises etc. are included in the circuit training.

### **WHAT RESEARCH SAYS?**

Treble had studied the effect of upper body specific circuit training on grade five children. For this purpose, total 50 males and females were selected for the sample, who were physically healthy. They were divided into two groups. Twelve males and 13 female members were included in the control group. The training group was given circuit training of 5 to 6 minutes for 6 weeks, three times per week. The test was based on

physical performance. The result indicated that difference was found between training group and control group, in which significant difference was seen in strength, muscular power and maximum power, where as no difference was found in anthropological aspects.

Charles had examined the effect of circuit training exercise on leg strength, speed and explosive strength. Total 20 male members of Frempolian handball were selected for the sample in this study. Six week training was provided. The test was held b before and after the completion of training. The result showed that improvement was seen in leg strength speed and explosive strength but no improvement was found in speed of running.

### **PURPOSE OF THE STUDY**

The purpose of the study was to see the effect of Plyometric and Circuit Training on Selected Physical Fitness Variables on school children.

### **HYPOTHESES**

- Significant effect will be found in Hand and Shoulder Muscle Strength of school children by Plyometric and Circuit Training.
- Significant effect will be found in Abdominal Strength of school children by Plyometric and Circuit Training.
- Significant effect will be found in Speed of school children by Plyometric and Circuit Training.
- Significant effect will be found in Standing Explosive Strength of Leg of school children by Plyometric and Circuit Training.
- Significant effect will be found in Agility of school children by Plyometric and Circuit Training.

### **METHODOLOGY**

#### **Selection of Subjects**

The purpose of the study was to see the effect of Plyometric and Circuit Training on Selected Physical Variables on school children. In order to draw an adequate representative sample, 150 boys from the 03 Schools namely Shri Sadguru High School, Bhinar, Ta. Vasnda, Dist. Navsari, Gnan Sarita Madhyamik Shala, Vangan, Ta. Vasnda, Dist. Navsari and Pragna Saurabh Madhyamik Shala, Manpur, Ta. Vasnda, Dist. Navsari were selected as subjects with age ranging between 14 to 16 years. Total 150 school children were selected as subjects for the sample of the present study, from which 50 children were included in the plyometric training group, 50 children in circuit training group and 50 children were included in the control group.

#### **Research Design**

Total 50 subjects were selected randomly for each group in the present study. The pretest of aspects of physical fitness was conducted on each group. Then, Group A was provided plyometric training and group–B, circuit training for 12 weeks. Group – C was accepted as the control group. Finally, the posttest was executed on all three groups.

The plyometric training group was made to take exercises such as hip twist, ankle hops, lateral cone hops, tuck jump with knee up, depth jump etc. whereas the circuit

training group was made to take exercises like Stepping up and down, Push-ups, Squats, Bent Knee Sit-Ups, Rope Jump.

**Tools:**

No.	Variable	Test	Measurement
1	Hand and Shoulder Muscle Strength	Pull Ups	Number
2	Abdominal Strength	Bent Knee Sit Ups	Number
3	Speed	50 Yard Dash	Time
4	Explosive Strength of Leg	Standing Broad Jump	Mtr./Cm.
5	Agility	Shuttle Run	Time

**STATISTICAL ANALYSIS OF THE DATA**

For the present study, Analysis of Covariance was applied to know the effects on plyometric training and circuit training. Mean difference was examined at 0.05 levels by using Least Significant Difference (Post Hoc) Test.

**Table – 1**

**Analysis of covariance of mean scores of Hand and Shoulder Muscle Strength of two experimental groups and a control group**

Test	Groups			Analysis of variance				
	Plyometric	Circuit	Control	Sum of classes (SS)	df	MSS	'F'	
Pre-Test Mean	6.32	6.74	6.86	A	8.04	2	4.02	1.497
				W	394.52	147	2.683	
Post-Test Mean	8.82	8.66	5.94	A	261.973	2	130.987	35.046*
				W	549.42	147	3.737	
Adjusted Mean	8.821	8.659	5.938	A	259.682	2	129.841	34.503*
				W	549.409	146	3.763	

**\*Significance Level at 0.05 'F' (2,147) = 3.057 & (2,146) = 3.058**

In the Table-1 above, the 'F' ratio of Post-Test Means of all the three groups (Plyometric Group = 8.82, Circuit Group = 8.66 Control Group = 5.94) was found 35.046. Comparing it with Table value (3.058) it was found significant at 0.05 level. Therefore, it is proved that, because of the given training, the performance of the subjects is improved significantly. In addition, the 'F' ratio of Adjusted Means (Plyometric Group = 8.821, Circuit Group = 8.659 Control Group = 5.938) was found to be 34.503. Comparing it with Table value (3.058) it was found significance at 0.05 level. The differences between Adjusted Means of all the three groups through 'F' ratio become significant. To check the significance of difference between Adjusted Means and to see which training was effective from the training is given to Plyometric Group and Circuit Groups the significance of Adjusted Means and critical difference was checked. It is shown in Table-2.

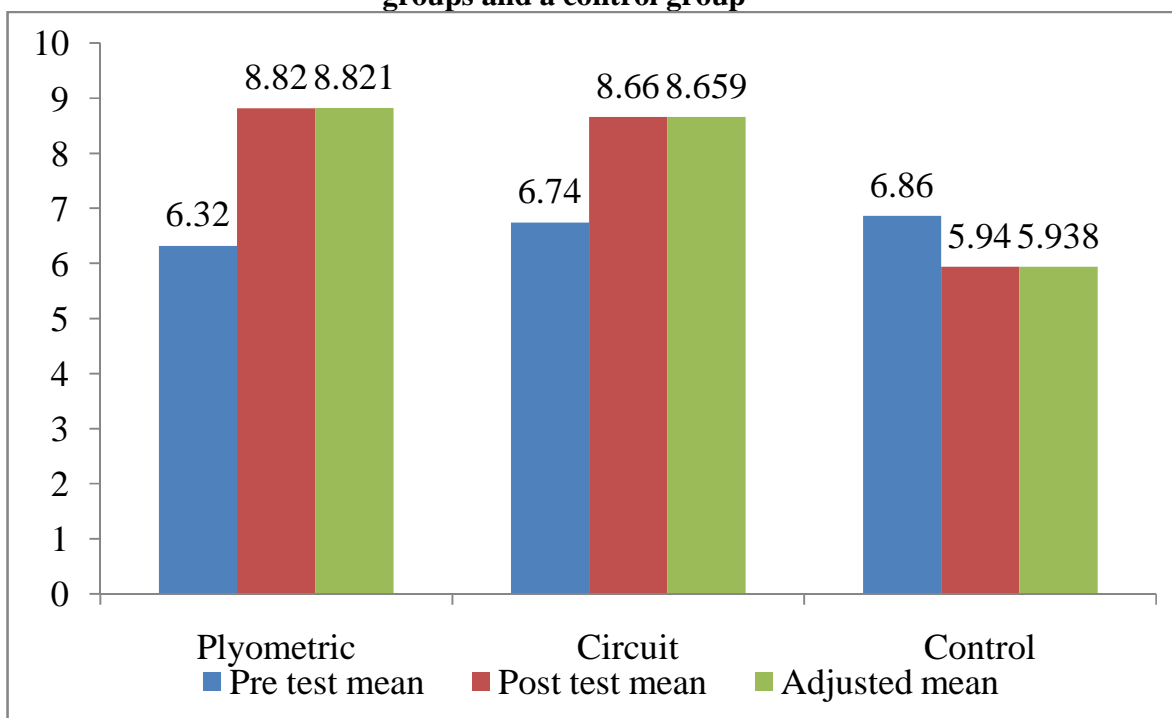
**Table – 2**  
**Critical difference of mean scores of Hand and Shoulder Muscle Strength of two experimental groups and a control group**

Mean			Mean Difference	Critical Difference
Plyometric Training	Circuit Training	Control Group		
8.821	8.659		0.162	<b>0.766</b>
8.821		5.938	2.882*	
	8.659	5.938	2.720*	

\* Significance at 0.05 levels

In the Table-2 above, the difference between Adjusted Means of pair of Two Experimental Group and control group in Hand and Shoulder Muscle Strength Test result can be seen clearly. The Data regarding mean difference shown in the above Table shows the difference between the Mean scores of Plyometric Group – Circuit Group, Plyometric Group – Control Group, Circuit Group – Control Group. Comparing it with Critical Difference, it becomes easy to know how much consecutive improvement was in the group due to the training. According to Table-2 very significant difference is observed in Plyometric Training Group with mean difference of 2.882. Thereafter, Circuit Training Group shows improvement with mean difference of 2.720. In comparison with Control group, the significant effect of practical training given to both the Experimental Groups of Plyometric Group and the Circuit Group was seen. Between two Experimental Groups no significant effect of practical training was seen. But, in comparison to Control Group, significant effect of practical training was seen in two Experimental Groups.

**Graph – 1 Mean scores of Hand and Shoulder Muscle Strength of two experimental groups and a control group**



**Table – 3**  
**Analysis of covariance of mean scores of Abdominal Strength**  
**of two experimental groups and a control group**

Test	Groups			Analysis of variance				
	Plyometric	Circuit	Control	Sum of classes (SS)	df	MSS	'F'	
Pre-Test Mean	17	16.94	16.8	A	1.053	2	0.526	0.099
				W	776.82	147	5.284	
Post-Test Mean	22.76	22.82	16.78	A	1204.093	2	602.047	56.837*
				W	1557.08	147	10.592	
Adjusted Mean	22.751	22.817	16.791	A	1196.221	2	598.111	56.331*
				W	1550.171	146	10.617	

**\*Significance Level at 0.05 'F' (2,147) = 3.057 & (2,146) = 3.058**

In the Table-3 above, the 'F' ratio of Post Test Means of all the three groups (Plyometric Group = 22.76, Circuit Group = 22.82 Control Group = 16.78) was found 56.837. Comparing it with Table value (3.058) it was found significant at 0.05 level. Therefore, it is proved that, because of the given training, the performance of the subjects is improved significantly. In addition, the 'F' ratio of Adjusted Means (Plyometric Group = 22.751, Circuit Group = 22.817 Control Group = 16.791) was found to be 56.331. Comparing it with Table value (3.058) it was found significance at 0.05 level. The differences between Adjusted Means of all the three groups through 'F' ratio become significant. To check the significance of difference between Adjusted Means and to see which training effective from Plyometric Group and Circuit Groups the significance of Adjusted Means and critical difference was checked. It is shown in Table-4.

**Table – 4**  
**Critical difference of mean scores of Abdominal Strength of two experimental groups and a control group**

Mean			Mean Difference	Critical Difference
Plyometric Training	Circuit Training	Control Group		
22.751	22.817		0.065	1.287
22.751		16.791	5.961*	
	22.817	16.791	6.026*	

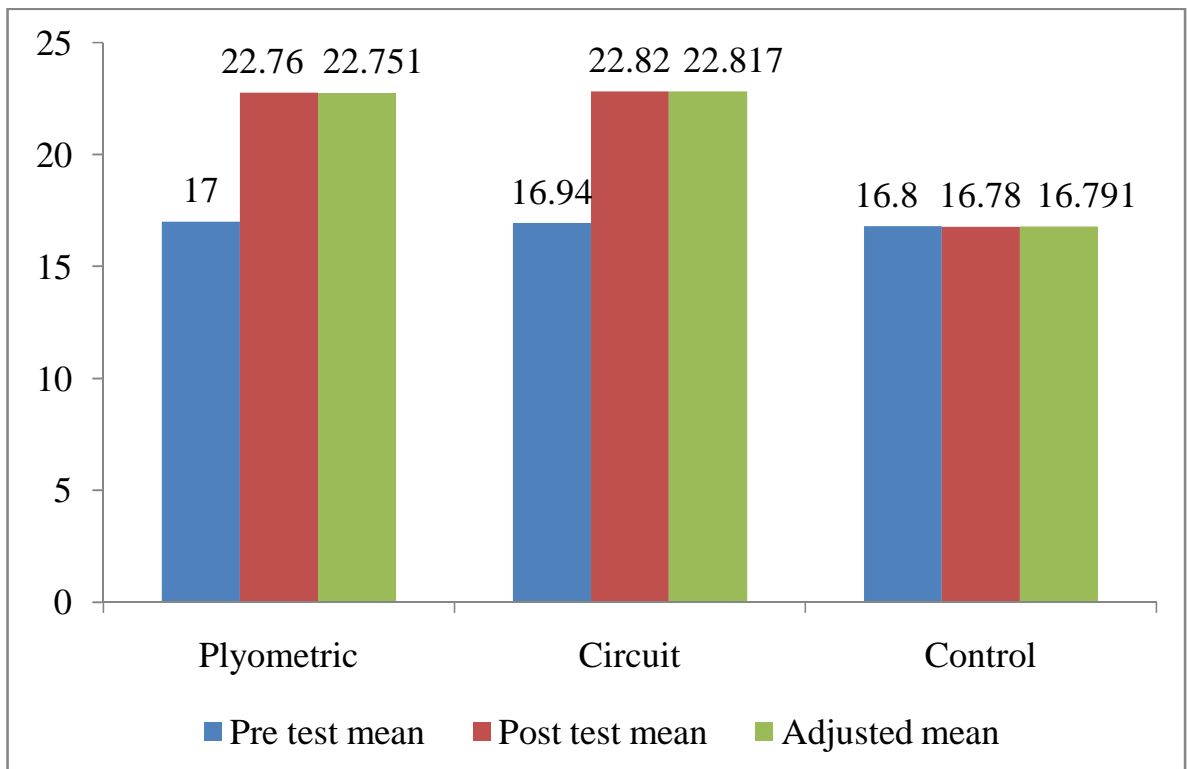
**\* Significance at 0.05 levels**

In the Table-4 above, the difference between Adjusted Means of pair of Two Experimental Group and control group in Abdominal Strength Test result can be seen clearly. The Data regarding mean difference shown in the above Table shows the difference between the Mean Differences of Plyometric Group – Circuit Group, Plyometric Group – Control Group, Circuit Group – Control Group. Comparing it with Critical Difference, it becomes easy to know how much consecutive improvement was in the group due to the training. According to Table-4 very significant difference is observed in Circuit Training Group with mean difference of 6.026. Thereafter,

Plyometric Training Group shows improvement with mean difference of 5.961. In comparison with Control group, the significant effect of practical training given to both the Experimental Groups of Plyometric Group and the Circuit Group was seen. Between two Experimental Groups no significant effect of practical training was seen. But, in comparison to Control Group, significant effect of practical training was seen in two Experimental Groups.

**Graph - 2**

**Mean scores of Abdominal Strength Test of two experimental groups and a control group**



**Table – 5**

**Analysis of covariance of mean scores of Speed of two experimental groups and a control group**

Test	Groups			Analysis of variance				'F'
	Plyometric	Circuit	Control	Sum of classes (SS)		df	MSS	
Pre-Test Mean	8.381	8.47	8.332	A	0.488	2	0.244	0.272
				W	131.841	147	0.896	
Post-Test Mean	7.71	7.974	8.498	A	16.116	2	8.058	7.918*
				W	149.596	147	1.017	
Adjusted Mean	7.720	7.913	8.549	A	18.798	2	9.399	21.933*
				W	62.563	146	0.428	

**\*Significance Level at 0.05 'F' (2,147) = 3.057 & (2,146) = 3.058**

In the Table-5 above, the 'F' ratio of Post-Test Means of all the three groups (Plyometric Group = 7.71, Circuit Group = 7.974 Control Group = 8.498) was found 7.918. Comparing it with Table value (3.058) it was found significant at 0.05 level. Therefore, it is proved that, because of the given training, the performance of the subjects is improved significantly. In addition, the 'F' ratio of Adjusted Means (Plyometric Group = 7.720, Circuit Group = 7.913 Control Group = 8.549) was found to be 21.933. Comparing it with Table value (3.058) it was found significance at 0.05 level. The differences between Adjusted Means of all the three groups through 'F' ratio become significant. To check the significance of difference between Adjusted Means and to see which training effective from the training is given to Plyometric Group and Circuit Groups the significance of Adjusted Means and critical difference was checked. It is shown in Table-6.

**Table – 6**

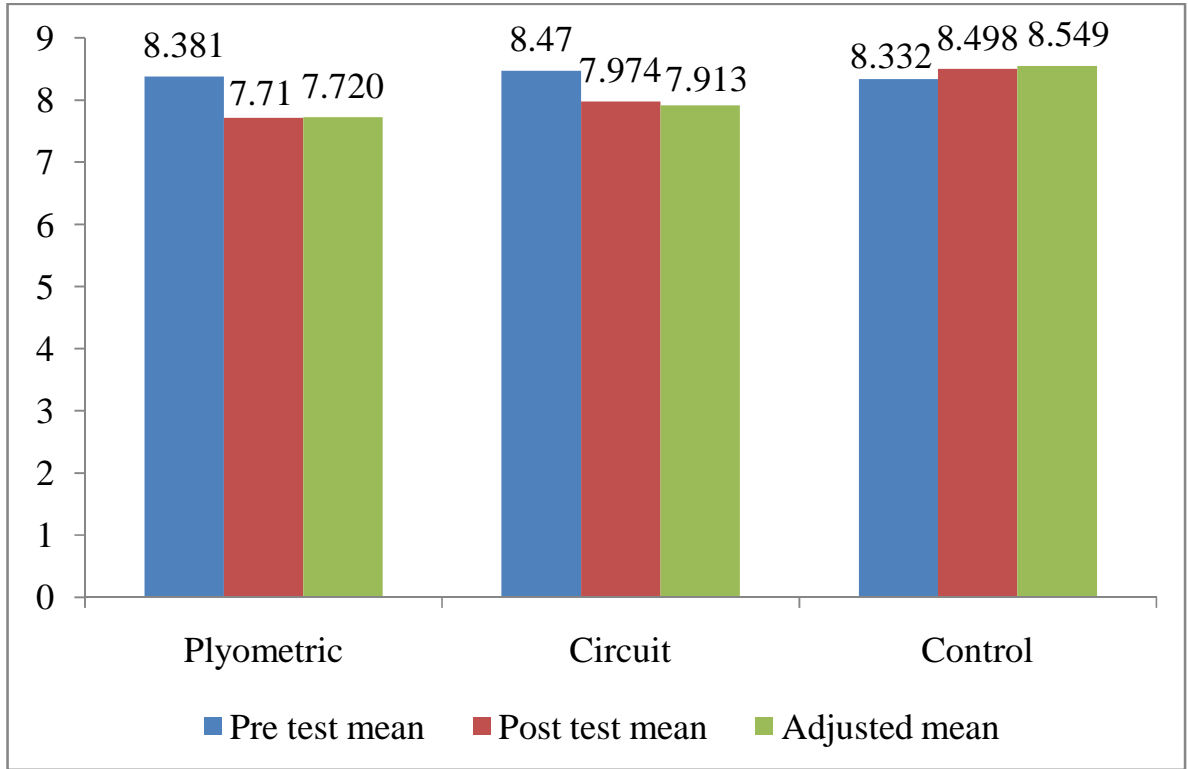
**Critical difference of mean scores of Speed of two experimental groups and a control group**

Mean			Mean Difference	Critical Difference
Plyometric Training	Circuit Training	Control Group		
7.720	7.913		0.192	<b>0.258</b>
7.720		8.549	0.829*	
	7.913	8.549	0.636*	

**\* Significance at 0.05 levels**

In the Table-6 above, the difference between Adjusted Means of pair of Two Experimental Group and control group in Speed Test result can be seen clearly. The Data regarding mean difference shown in the above Table shows the difference between the Mean Differences of Plyometric Group – Circuit Group, Plyometric Group – Control Group, Circuit Group – Control Group. Comparing it with Critical Difference, it becomes easy to know how much consecutive improvement was in the group due to the training. According to Table-6 very significant difference is observed in Plyometric Training Group with mean difference of 0.829. Thereafter, Circuit Training Group shows improvement with mean difference of 0.636. In comparison with Control group, the significant effect of practical training given to both the Experimental Groups of Plyometric Group and the Circuit Group was seen. Between two Experimental Groups no significant effect of practical training was seen. But, in comparison to Control Group, significant effect of practical training was seen in two Experimental Groups.

**Graph - 3**  
**Mean scores of Speed Test of two experimental groups and a control group**



**Table - 7**  
**Analysis of covariance of mean scores of Explosive Strength of Leg of two experimental groups and a control group**

Test	Groups			Analysis of variance				
	Plyometric	Circuit	Control	Sum of classes (SS)	df	MSS	'F'	
Pre-Test Mean	1.617	1.662	1.627	A	0.056	2	0.028	0.412
				W	10.083	147	0.068	
Post-Test Mean	1.778	1.786	1.601	A	1.089	2	0.544	6.183*
				W	12.954	147	0.088	
Adjusted Mean	1.793	1.763	1.608	A	0.990	2	0.495	12.509*
				W	5.777	146	0.039	

\*Significance Level at 0.05 'F' (2,147) = 3.057 & (2,146) = 3.058

In the Table-7 above, the 'F' ratio of Post Test Means of all the three groups (Plyometric Group = 1.778, Circuit Group = 1.786 Control Group = 1.601) was found 6.183. Comparing it with Table value (3.058) it was found significant at 0.05 level. Therefore, it is proved that, because of the given training, the performance of the subjects



is improved significantly. In addition, the 'F' ratio of Adjusted Means (Plyometric Group = 1.793, Circuit Group = 1.763 Control Group = 1.608) was found to be 12.509. Comparing it with Table value (3.058) it was found significance at 0.05 level. The differences between Adjusted Means of all the three groups through 'F' ratio become significant. To check the significance of difference between Adjusted Means and to see which training effective from the training is given to Plyometric Group and Circuit Groups the significance of Adjusted Means and critical difference was checked. It is shown in Table-8.

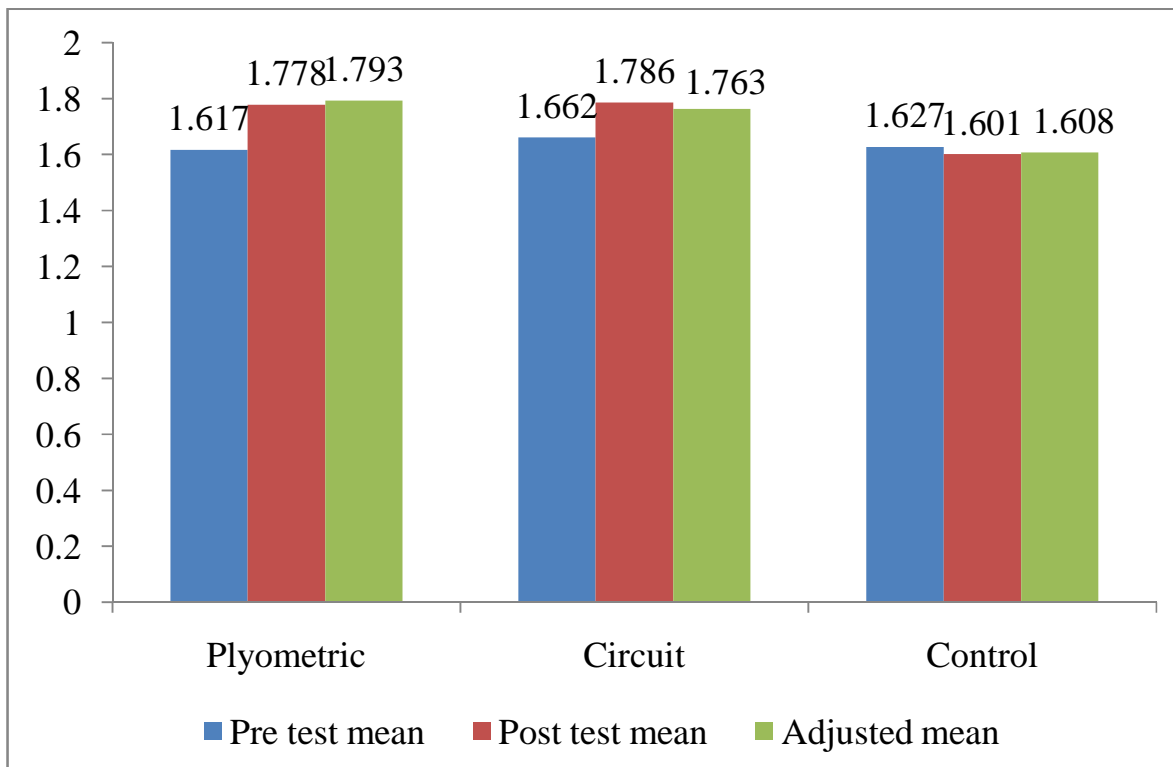
**Table – 8**  
**Critical difference of mean scores of Explosive Strength**  
**of Leg of two experimental groups and a control group**

Mean			Mean Difference	Critical Difference
Plyometric Training	Circuit Training	Control Group		
1.793	1.763		0.030	<b>0.078</b>
1.793		1.608	0.185*	
	1.763	1.608	0.155*	

\* Significance at 0.05 levels

In the Table-8 above, the difference between Adjusted Means of pair of Two Experimental Group and control group in Explosive Strength of Leg Test result can be seen clearly. The Data regarding mean difference shown in the above Table shows the difference between the Mean Differences of Plyometric Group – Circuit Group, Plyometric Group – Control Group, Circuit Group – Control Group. Comparing it with Critical Difference, it becomes easy to know how much consecutive improvement was in the group due to the training. According to Table-8 very significant difference is observed in Plyometric Training Group with mean difference of 0.185 Thereafter, Circuit Training Group shows improvement with mean difference of 0.155. In comparison with Control group, the significant effect of practical training given to both the Experimental Groups of Plyometric Group and the Circuit Group was seen. Between two Experimental Groups no significant effect of practical training was seen. But, in comparison to Control Group, significant effect of practical training was seen in two Experimental Groups.

**Graph - 4**  
**Mean scores of Explosive Strength of Leg Test of two experimental groups and a control group**



**Table – 9**  
**Analysis of covariance of mean scores of Agility of two experimental groups and a control group**

Test	Groups			Analysis of variance				
	Plyometric	Circuit	Control	Sum of classes (SS)	df	MSS	'F'	
Pre-Test Mean	11.561	11.64	11.661	A	0.276	2	0.138	0.366
				W	55.515	147	0.377	
Post-Test mean	10.911	11.023	11.656	A	16.115	2	8.057	19.132*
				W	61.912	147	0.421	
Adjusted Mean	10.944	11.012	11.633	A	14.350	2	7.175	23.706*
				W	44.189	146	0.302	

\*Significance Level at 0.05 'F' (2,147) = 3.057 & (2,146) = 3.058

In the Table-9 above, the 'F' ratio of Post-Test Means of all the three groups (Plyometric Group = 10.911, Circuit Group = 11.023 Control Group = 11.656) was found 19.132. Comparing it with Table value (3.058) it was found significant at 0.05 level. Therefore, it is proved that, because of the given training, the performance of the subjects

is improved significantly. In addition, the 'F' ratio of Adjusted Means (Plyometric Group = 10.944, Circuit Group = 11.012 Control Group = 11.633) was found to be 23.706. Comparing it with Table value (3.058) it was found significance at 0.05 level. The differences between Adjusted Means of all the three groups through 'F' ratio become significant. To check the significance of difference between Adjusted Means and to see which training effective from the training is given to Plyometric Group and Circuit Groups the significance of Adjusted Means and critical difference was checked. It is shown in Table-10.

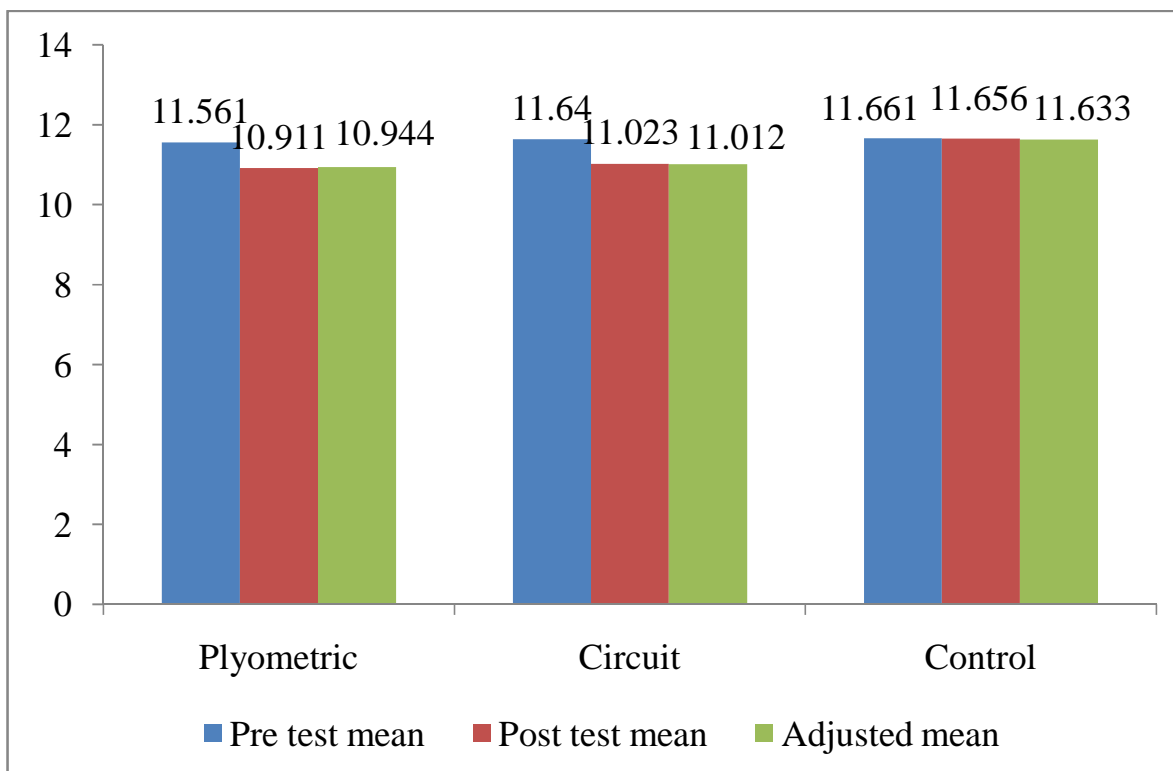
**Table – 10**  
**Critical difference of mean scores of Agility of two experimental groups and a control group**

Mean			Mean Difference	Critical Difference
Plyometric Training	Circuit Training	Control Group		
10.944	11.012		0.067	<b>0.217</b>
10.944		11.633	0.688*	
	11.012	11.633	0.620*	

\* Significance at 0.05 levels

In the Table-10 above, the difference between Adjusted Means of pair of Two Experimental Group and control group Agility Test result can be seen clearly. The Data regarding mean difference shown in the above Table shows the difference between the Mean Differences of Plyometric Group – Circuit Group, Plyometric Group – Control Group, Circuit Group – Control Group. Comparing it with Critical Difference, it becomes easy to know how much consecutive improvement was in the group due to the training. According to Table-10 very significant difference is observed in Plyometric Training Group with mean difference of 0.688 Thereafter, Circuit Training Group shows improvement with mean difference of 0.620. In comparison with Control group, the significant effect of practical training given to both the Experimental Groups of Plyometric Group and the Circuit Group was seen. Between two Experimental Groups no significant effect of practical training was seen. But, in comparison to Control Group, significant effect of practical training was seen in two Experimental Groups.

**Graph - 5**  
**Mean scores of Agility Test of two experimental groups and a control group**



**DISCUSSION OF HYPOTHESES**

No.	Hypothesis	'F' ratio	Significance level 0.05	Accepted / Rejected
1	Significant effect will be found in Hand and Shoulder Muscle Strength of school children by Plyometric and Circuit Training.	34.503*	(2,147) = 3.057 & (2,146) = 3.058	Accepted
2	Significant effect will be found in Abdominal Strength of school children by Plyometric and Circuit Training.	56.331*	(2,147) = 3.057 & (2,146) = 3.058	Accepted
3	Significant effect will be found in Speed of school children by Plyometric and Circuit Training.	21.933*	(2,147) = 3.057 & (2,146) = 3.058	Accepted
4	Significant effect will be found in Standing	12.509*	(2,147) =	Accepted

	Explosive Strength of Leg of school children by Plyometric and Circuit Training.		3.057 & (2,146) = 3.058	
5	Significant effect will be found in Agility of school children by Plyometric and Circuit Training.	23.706*	(2,147) = 3.057 & (2,146) = 3.058	Accepted

## CONCLUSIONS

- It is hereby clear that, due to Plyometric and Circuit training, significant improvement is seen in the performance of subjects in Hand and Shoulder Muscle Strength with comparison to the Control Group. Noteworthy improvement is seen in Hand and Shoulder Muscle Strength of the subjects selected through 12 weeks training.
- It is hereby clear that, due to Plyometric and Circuit training, significant improvement is seen in the performance of subjects in Abdominal Strength with comparison to the Control Group. Noteworthy improvement is seen in Abdominal Strength Test of the subjects selected through 12 weeks training.
- It is hereby clear that, due to Plyometric and Circuit training, significant improvement is seen in the performance of subjects in Speed with comparison to the Control Group. Noteworthy improvement is seen in Speed Test of the subjects selected through 12 weeks training.
- It is hereby clear that, due to Plyometric and Circuit training, significant improvement is seen in the performance of subjects in Explosive Strength of Leg with comparison to the Control Group. Noteworthy improvement is seen in Explosive Strength of Leg Test of the subjects selected through 12 weeks training.
- It is hereby clear that, due to Plyometric and Circuit training, significant improvement is seen in the performance of subjects in Agility with comparison to the Control Group. Noteworthy improvement is seen in Agility of the subjects selected through 12 weeks training.

## REFERENCES

- Sharma, R. K. (2000) Scientific Principles of Sports Training, 1<sup>st</sup> Ed., Sports Material Publication, New Delhi, India.
- Clark, H. Harrison & Clark, David H. (1987) Application of Measurement to Physical Education, Printing Hall Inc., New Jersey.
- Patel, Harshad I. & Patel, Digisha H. (1996) Training Methods and Competition Planning in Physical Education and Sports, 1<sup>st</sup> Ed., Krishna Graphics, Ahmedabad, Gujarat, India.
- Charles, Grassy (1967) The effect of circuit training exercise on leg strength, speed and explosive strength, Completed Research in Health Physical Education and Recreation.
- Trebly, Marc (1986) The effect of upper body specific circuit training on grade five children, Journal of Physical Education and Sports Science.