The Effect of High Intensity and Low Intensity Circuit Training on Strength Endurance of Male School Children

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Abstract – For the purpose of the study thirty subjects were selected randomly from Government Senior Secondary School, Sonepat. Further, all the subjects were randomly divided into three groups i.e. two experimental groups (group A and group B) and one control group. Each group contain 10 subjects. Group A was considered as High Intensity Circuit Training Group and Group B was Low Intensity Circuit Training Group whereas group C was considered as control group. The intensity was determined by calculating Maximum Heart Rate by using Karvonen formula. Experimental groups had undergone the treatment of circuit training. First experimental group (G1) practiced High Intensity Circuit Training programme and second experimental group (G2) practiced Low Intensity circuit Training programme whereas no training was given to control group (G3) apart from their daily schedule for 08 weeks. Experimental groups were imparted 50 minutes of Resistance Training three times a week. Strength endurance variables are Arms and shoulder strength endurance, abdominal strength endurance and Quadriceps strength endurance. Arms and shoulder strength endurance was measured by push-ups and recorded in numbers. Abdominal strength endurance was measured by sit ups and recorded in numbers. Quadriceps strength endurance was measured by squat and recorded in numbers. The statistical techniques ANCOVA was employed to find out the effect of high intensity circuit training and low intensity circuit training in experimental group and control group on selected variable of Strength Endurance (Arms & Shoulder, Abdominal, and Quadriceps).

Significant improvement was found in Strength Endurance (Arms & Shoulder, Abdominal and Quadriceps) as a result of the experimental treatments namely high intensity and low intensity circuit training. Significant difference also found in high intensity circuit training, low intensity circuit training and control groups for development of Strength Endurance (Arms & Shoulder, Abdominal, and Quadriceps) high intensity circuit training experimental group found better then low intensity circuit training group and low intensity circuit training group is better than control group.

Keyword: Strength endurance, Circuit Training, High Intensity, Low Intensity.

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INTRODUCTION

The lack of physical activity is a multidimensional problem, associated with changes in our lifestyles changes in school policies and changes in the communities in which we live. All of these have contributed to a lack of physical activity of children and adults and because there is no cause, there is no one easy solution. Lifestyle Issues, One the major problem we have living in this century is that the technological advances of the past century were designed to remove physical activity from our lives, to make life easier for us. If we want to increase physical activity, we will need to find ways to put it back into our lives and find time in our schedules for it. Even in states that require physical education, 58% allow substitutions, and many students at elementary level are being pulled out of their physical education classes to receive remedial help in academics.

Muscular strength and endurance are two important parts of your body's ability to move, lift things and do day-to-day activities. Muscular strength is the amount of force you can put out or the amount of weight you can lift. Muscular endurance is how many times you can move that weight without getting exhausted (very tired). All forms of competition, however, necessitate maximal output over the duration of the event. It is not always the strongest athlete who wins in all cases, the one that can sustain the most power over the full term of the activity. Therefore, the development of all the various types of muscle fibers benefits the athlete(Fleck and Kraemer, 2004).The fast twitch muscle fibers create maximum power

output in explosive sports such as sprinting and weightlifting. Slow twitch fibers are the prime fiber cells used in long-distance aerobic events. Combining, and training, these two types of fibers at all speeds and angles produces strength endurance. There are muscle fibers that are not what you would call exclusively fast twitch or exclusively slow twitch (Brunner and Tabachnik 1990) They are a combination of the two not fully fast twitch or fully slow twitch. But, strengthening these muscle fibers will enable a greater expression of strength endurance to occur (Bompa, 1999). Another aspect to this particular strength continuum is dynamic and static strength endurance which can be improved by following proper training schedules. The athletic movements and the muscular tension displayed during these movements differentiate between these two forms of strength endurance. Endurance is thus a matter of dividing muscle tension into large or moderate magnitudes and the length of time for each. Dynamic strength-endurance is typically associated with cyclic exercises in which considerable tension is repeated without interruption during each cycle of movement (Stiff 2000).

METHODOLOGY

For the purpose of the study thirty subjects were selected randomly from Government Senior Secondary School, Sonepat. Further, all the subjects were randomly divided into three groups i.e. two experimental groups (group A and group B) and one control group. Each group contain 10 subjects. Group A was considered as High Intensity Circuit Training Group and Group B was Low Intensity Circuit Training Group whereas group C was considered as control group. The intensity was determined by calculating Maximum Heart Rate by using Karvonen formula. Experimental groups had undergone the treatment of circuit training. First experimental group (G1) practiced High Intensity Circuit Training programme and second experimental group (G2) practiced Low Intensity circuit Training programme whereas no training was given to control group (G3) apart from their daily schedule for 08 weeks. Experimental groups were imparted 50 minutes of Resistance Training three times a week.

Strength endurance variables are Arms and shoulder strength endurance, abdominal strength endurance and Quadriceps strength endurance. Arms and shoulder strength endurance was measured by push-ups and recorded in numbers. Abdominal strength endurance was measured by sit ups and recorded in numbers. Quadriceps strength endurance was measured by squat and recorded in numbers. The statistical techniques ANCOVA was employed to find out the effect of high intensity circuit training and low intensity circuit training in experimental group and control group on selected variable of Strength Endurance (Arms & Shoulder, Abdominal, and Quadriceps).

RESULT

Table:-1 Group-wise Test of Normality for Strength Endurance

Strength Endurance	Group	Shapiro –Wilk		Significant Level
		Statistics	df	
Arms and Shoulder	HICT	0.840	10	0.045
	LICT	0.943	10	0.584
	Control	0.977	10	0.946
Abdominal	HICT	0.909	10	0.271
	LICT	0.976	10	0.937
	Control	0.937	10	0.517
Quadriceps	HICT	0.833	10	0.036
	LICT	0.960	10	0.788
	Control	0.930	10	0.448

Table-1 reveals that Shapiro –Wilk coefficients of normality of data for Strength Endurance (Arms & Shoulder, Abdominal & Quadriceps) were not found to be significant. It shows that data were normally distributed. But in case of High Intensity Circuit Training, Arms & Shoulder Strength Endurance and Quadriceps Strength Endurance data were not normally distributed.

Table : 2 Group-wise Test of Homogeneity of Variances for Strength Endurance

Strength Endurance	Levene Statistic	df1	df2	Significant Level
Arms & Shoulder	.289	2	27	0.751
Abdominal	1.618	2	27	0.217
Quadriceps	1.423	2	27	.259

Table-2 stated assumption of homogeneity of variance was accomplished in case of Strength Endurance (Arms & Shoulder, Abdominal& Quadriceps) as Levene's Test coefficients were not found to be significant. Thus equal variances were assumed among High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT) and Control Groups.

Table:3- Summary of One Way ANCOVA of Arms & Shoulder Strength Endurance by taking Pre-Arms & Shoulder Strength Endurance of subjects as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$–Value	Significant Level	Effect Size
Training Groups	2	369.46	184.73	108.62	p<0.05	0.89
Error	26	44.22	1.70			
Total	30	22953.0				

From the Table 3, it is evident that the adjusted F-value of Arms & Shoulder Strength Endurance is 108.62 which is significant at 0.05 level with df =2, 26. It revealed that the adjusted mean scores of Arms & Shoulder Strength Endurance of subjects belonging to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT) and Control Groups differ significantly when Pre – Arms & Shoulder Strength Endurance was taken as covariate. 89% change in Arms & Shoulder Strength Endurance can be attributed to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control.

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Thus the null hypothesis there is no significant difference in adjusted mean scores of Strength Endurance (Arms & Shoulder) of High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT) and Control Groups by taking their Pre – Arms & Shoulder Strength Endurance as covariate is rejected. In order to know which group's adjusted mean score of Arms & Shoulder Strength Endurance is significantly different, the data were further analysed with the help of Least Significant Difference Test (LSD) and the results are given in Table 4.

Table:4 Group-wise adjusted mean, SE and significance of difference between adjusted means scores of Arms & Shoulder Strength Endurance of subjects

Groups	Adjusted mean	SE	Low Intensity Circuit Training Group	Control Group
High Intensity Circuit Training Group	31.33	0.45	4.006*	10.679*
Low Intensity Circuit Training Group	27.32	0.42		6.673*
Control Group	20.65	0.49		

*Significant at 0.05 level

From Table 4 it can be seen that the adjusted mean scores of Arms & Shoulder Strength Endurance of High Intensity Circuit Training (HICT) Group and Low Intensity Circuit Training (LICT) Group differ significantly at 0.05 level. Further the adjusted mean score of Arms & Shoulder Strength Endurance of (HICT) Group is 31.33 which is significantly higher than that of (LICT) Group whose adjusted mean score of Arms & Shoulder Strength Endurance is 27.32. It may, therefore, be said that subjects of (HICT) Group were found to have higher Arms & Shoulder Strength Endurance as compared to those of(LICT) Group.

Also the adjusted mean scores of Arms & Shoulder Strength Enduranceof (HICT) Group and Control Group differ significantly at 0.05 level (Vide Table 4). Further the adjusted mean score of Arms & Shoulder Strength Enduranceof (HICT) Group is 31.33 which is significantly higher than that of Control Group whose adjusted mean score of Arms & Shoulder Strength Enduranceis 20.65. It may, therefore, be said that subjects of (HICT) Group were found to have significantly higher Arms & Shoulder Strength Endurance as compared of Control Group.

Lastly the adjusted mean scores of Arms & Shoulder Strength Enduranceof (LICT) Group and Control Group differ significantly at 0.05 level (Vide Table 4). Further the adjusted mean score of Arms & Shoulder Strength Enduranceof (LICT) Group is 27.32 which is significantly higher than those of Control Group whose adjusted mean score of Arms & Shoulder Strength Enduranceis 20.65. It may, therefore, be said that subjects of (LICT) Group were found to have

significantly higher Strength Endurance Arms & Shoulder Strength Endurance as compared of Control Group.

On the whole it may be said that Subjects of (HICT) Group were found to have significantly higher Arms & Shoulder Strength Enduranceas compared to their counter parts of (LICT) Group and Control Group. Also the Arms & Shoulder Strength Enduranceof subjects of (LICT) Group was found to be significantly higher than those of Control Group.

Table 5: Summary of One Way ANCOVA of Abdominal Strength Endurance by taking Pre-Abdominal Strength Endurance of subjects as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$–Value	Significant Level	Effect Size
Training Groups	2	311.86	155.93	22.53	p<0.05	0.63
Error	26	179.88	6.91			
Total	30	43123.0				

From the Table 5, it is evident that the adjusted F-value of Abdominal Strength Endurance is 22.53 which is significant at 0.05 level with df =2, 26. It revealed that the adjusted mean scores of Abdominal Strength Endurance of subjects belonging to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control Groups differ significantly when Pre – Abdominal Strength Endurance was taken as covariate.63% change in Abdominal Strength Endurance can be attributed to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control. Thus the null hypothesis there is no significant difference in adjusted mean scores of Abdominal Strength Endurance of High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control Groups by taking their Pre – Abdominal Strength Endurance as covariate is rejected. In order to know which group's adjusted mean score of Strength Abdominal Strength Endurance is significantly different, the data were further analysed with the help of Least Significant Difference Test (LSD) and the results are given in Table 6.

Table 6: Group-wise adjusted mean, SE and significance of difference between adjusted means scores of Strength Endurance (Sit-ups) of subjects

Group	Adjusted mean	SE	Low Intensity Circuit Training Group	Control Group
High Intensity Circuit Training Group	40.79	0.83	2.738*	7.955*
Low Intensity Circuit Training Group	38.05	0.85		5.217*
Control Group	32.84	0.85		

*Significant at 0.05 level

From Table-6 it can be seen that the adjusted mean scores of Abdominal Strength Endurance of High Intensity Circuit Training (HICT) Group and Low Intensity Circuit Training (LICT) Group differ significantly at 0.05 level.

Further the adjusted mean score ofAbdominal Strength Endurance of (HICT) Group is 40.79 which is significantly higher than that of (LICT) Group whose adjusted mean score ofAbdominal Strength Endurance is 38.05. It may, therefore, be said that subjects of (HICT) Group were found to have higher Abdominal Strength Endurance as compared to those of (LICT) Group.

Also the adjusted mean scores of Abdominal Strength Endurance of (HICT) Group and Control Group differ significantly at 0.05 level (Vide Table 6). Further the adjusted mean score of Abdominal Strength Endurance of (HICT) Group is 40.79 which is significantly higher than that of Control Group whose adjusted mean score of Abdominal Strength Endurance is 32.84. It may, therefore, be said that subjects of (LICT) Group were found to have significantly higher Abdominal Strength Endurance as compared of Control Group.

Lastly the adjusted mean scores of Abdominal Strength Endurance of(LICT) Group and Control Group differ significantly at 0.05 level (Vide Table 6). Further the adjusted mean score ofAbdominal Strength Endurance of (LICT) Group is 38.05 which is significantly higher than those of Control Group whose adjusted mean score of Abdominal Strength Endurance is 32.84. It may, therefore, be said that subjects of (LICT) Group were found to have significantly higher Abdominal Strength Endurance as compared of Control Group.

On the whole it may be said that Subjects of (HICT) Group were found to have significantly higher Abdominal Strength Endurance as compared to their counter parts of (LICT) Group and Control Group. Also the Abdominal Strength Endurance of subjects of (LICT) Group was found to be significantly higher than those of Control Group.

Table 7: Summary of One Way ANCOVA of Quadriceps Strength Endurance by taking Pre-Quadriceps Strength Endurance of subjects as covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$–Value	Significant Level	Effect Size
Training Groups	2	2335.77	1167.88	79.55	p<0.05	0.86
Error	26	381.71	14.68			
Total	30	157307.0				

From the Table 7, it is evident that the adjusted F-value of Quadriceps Strength Endurance is 79.55 which is significant at 0.05 level with df =2, 26. It revealed that the adjusted mean scores of Quadriceps Strength Endurance of subjects belonging to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control Groups differ significantly when Pre – Quadriceps Strength Endurance was taken as covariate.86% change in Quadriceps Strength Endurance can be attributed to High Intensity Circuit Training (HICT) & Low Intensity Circuit Training(LICT)and Control. Thus the null hypothesis there is no significant difference in adjusted mean scores of Quadriceps Strength Endurance of High Intensity Circuit Training (HICT) & Low Intensity Circuit Training (LICT)and Control Groups by taking their Pre – Quadriceps Strength Endurance as covariate is rejected. In order to know which group's adjusted mean score of Quadriceps Strength Endurance is significantly different, the data were further analysed with the help of Least Significant Difference Test (LSD) and the results are given in Table 8.

Table 8 : Group-wise adjusted mean, SE and significance of difference between adjusted means scores of Quadriceps Strength Endurance of subjects

Group	Adjusted mean	SE	Low Intensity Circuit Training Group	Control Group
High Intensity Circuit Training Group	80.78	1.48	8.19*	21.449*
Low Intensity Circuit Training Group	72.58	1.75		13.252*
Control Group	59.33	1.27		

*Significant at 0.05 level

From Table 8 it can be seen that the adjusted mean scores of Quadriceps Strength Endurance of High Intensity Circuit Training (HICT) Group and Low Intensity Circuit Training (LICT) Group differ significantly at 0.05 level.

Further the adjusted mean score of Quadriceps Strength Endurance of (HICT) Group is 80.78which is significantly higher than that of (HICT) Group whose adjusted mean score of Quadriceps Strength Endurance is 72.58. It may, therefore, be said that subjects of (HICT) Group were found to have higher Quadriceps Strength Endurance as compared to those of (LICT) Group.

Also the adjusted mean scores of Quadriceps Strength Endurance of (HICT) Group and Control Group differ significantly at 0.05 level (Vide Table 8). Further the adjusted mean score of Quadriceps Strength Endurance of (HICT) Group is 80.78 which is significantly higher than that of Control Group whose adjusted mean score of Quadriceps Strength Endurance is 72.58. It may, therefore, be said that subjects of (LICT) Group were found to have significantly higher Quadriceps Strength Endurance as compared of Control Group.

Lastly the adjusted mean scores of Quadriceps Strength Endurance of(LICT) Group and Control

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Group differ significantly at 0.05 level (Vide Table 8). Further the adjusted mean score Quadriceps Strength Endurance of(LICT) Group is 72.58 which is significantly higher than those of Control Group whose adjusted mean score of Quadriceps Strength Endurance is 59.33. It may, therefore, be said that subjects of (LICT) Group were found to have significantly higher Quadriceps Strength Endurance as compared of Control Group.

On the whole it may be said that Subjects of (HICT) Group were found to have significantly higher Quadriceps Strength Endurance as compared to their counter parts of (LICT) Group and Control Group. Also the Quadriceps Strength Endurance of subject of (LICT) Group was found to be significantly higher than those of Control Group.

Figure : Adjusted mean scores of Arms & shoulder, Abdominal and Quadriceps Strength Endurance of High Intensity Circuit Training Group and Low Intensity Circuit Training Group and Control groups
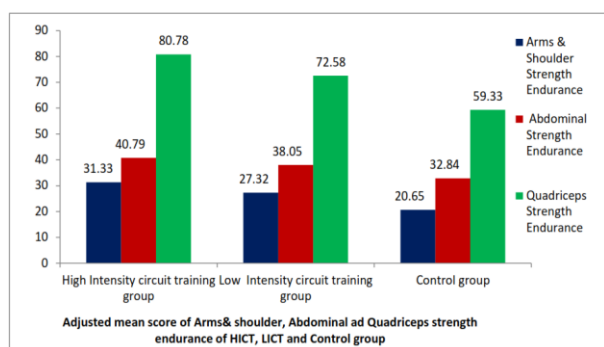
DISCUSSION OF FINDING

The results of the study revealed that experimental groups (high intensity and low intensity circuit training group) had significant difference with control group in Body Composition (Body weight, Lean Weight, Fat Weight) and Strength Endurance (Push-up, Sit-ups, Squat) of male school children as a result of eight weeks treatment. Circuit training is a quick way to get in an intense workout and it consists of a series of exercises or workout stations completed in succession with minimal rest periods in between involving own body resistance. Circuit routines allow the athlete or coach to create an endless number of workouts and add variety to routine training programs. This training helps to build muscles, and quickly transitioning from one to the next keeps heart rate high which elevate muscle mass and resulted improvement of strength endurance. Previous studies in which children performed an extra-curricular circuit training program confirmed a significant improvement on both muscular and cardio respiratory fitness (Annesi et al., 2005 ; Ignico and Mahon, 1995 ; Wong et al., 2008). Alagesan et al. (2012)showed that there was a significant difference between circuit resistance

training group and control group on leg strength and strength endurance.

CONCLUSION

Significant improvement was found in Strength Endurance (Arms & Shoulder, Abdominal and Quadriceps) as a result of the experimental treatments namely high intensity and low intensity circuit training. Significant difference also found in high intensity circuit training, low intensity circuit training and control groups for development of Strength Endurance (Arms & Shoulder, Abdominal, and Quadriceps) high intensity circuit training experimental group found better then low intensity circuit training group and low intensity circuit training group is better than control group.

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