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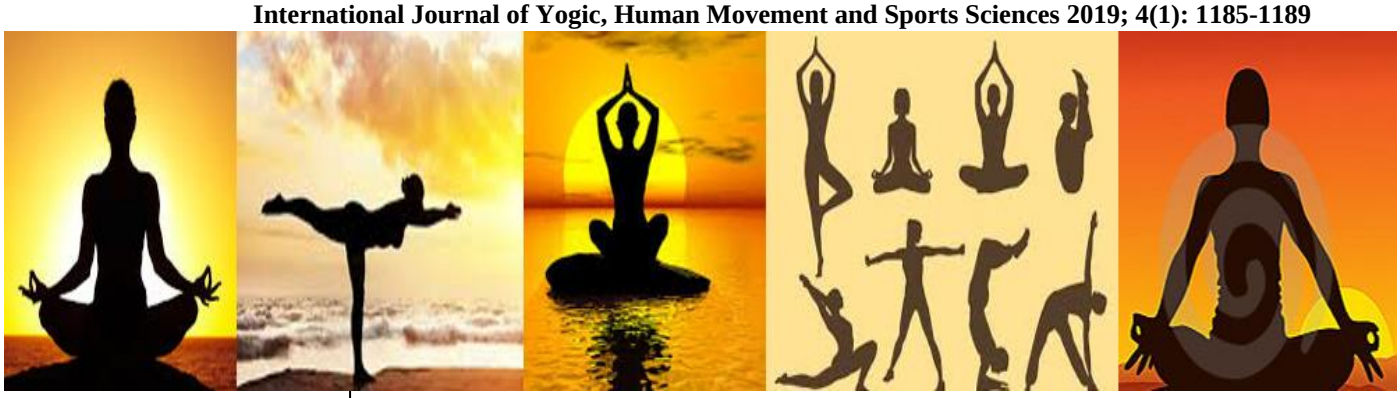

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Effects of circuit training programme on aerobic capacity, speed and explosive strength performance of school children

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Abstract
The present study aimed at testing the effects of circuit training programme on the aerobic capacity, speed and explosive strength performance of the school children of Delhi. For the same, the researcher has selected 40 children for both the groups i.e. experimental and control. The children were having age ranged between 16 ± 2 years. A circuit training program has been implemented on the experimental group whereas the control group did not get any treatment. The pre data from both the groups has been collected in advance prior to the training. After a training period of 12 weeks training (4 days a week), the post data has been collected. For the data analysis, the researcher has employed all the tests which test the assumptions of analysis of covariance. The results of ANCOVA has showed that the training has put significant impact on the dependent variables and it was found effective.

Keywords: Training, aerobic, speed, explosive strength, school children

Introduction
Sports scientists and coaches have always strived to device innovative and effective training strategies in order to enhance performance and aid in the developent of motor abilities required for particular sports. It may be correctly argued that the physical training is required for the development of the necessary physiological advancements (Nadori, I. and I. Granek. Theoratical, 1989) [4]. The proportions of different motor abilities are required to be included in the training programs in a proportion so that at the time of competition, maximum performance could be achieved. Most of the past researches have been investigating the effect of these training methodologies on the performance variables of the adult athlete. Since the training these days has to be initiated at an early age for excelling in sports. For achieving higher level of performance at any stage, the pre requisite is physical fitness and a balance proportion of development of all components of physical fitness. In the early stages i.e. school age children need to develop the fitness components in such a way that no component of fitness is neglected. Vital capacity indicates the aerobic fitness of an individual. Endurance training has a positive effect on the vital capacity of the individual. Regular aerobic training helps in the development of efficient lung capacity variables. The aerobic endurance depends upon the factors such as aerobic power, pulmonary systems, cardiac output, oxygen transport and composition of skeletal muscles. (Bassett, D R, Jr. and Et Howley, 2000) [1] Speed development is the resultant of the endurance and strength. The ATP-CP mechanism is involved in the activities pertaining to speed (Volek, J.S. and W.J. Kreamer.). The speed performance depends upon various factors such as neural, muscle activation, stretch reflex, neural fatigue etc. (Ross, A., M Leveritte, 2001.) [6] The ATP CP mechanism is developed by the activities of high intensity and short burst in nature. Explosive strength in the study is tested by vertical jump test. The explosive strength performance requires efficient proprioceptive system which is possible when the neuromuscular system is working effectively. The performance of these variables largely depends upon the dynamics of training and intensity (Stone and M. H., M. E. Stone and W. A. Sands, 2007) [7]. In circuit training the dynamics of volume and intensity predominantly determine the effect on the particular component of fitness. The nature of exercise also plays an important role in the development of the particular component of fitness.

Circuit training includes various training stations arranged is such a way that each station offers training for different groups of muscles. In circuit training proper care is given to rest and work so that particular energy system is emphasized. In the present exercises are chosen in such a way that the component of endurance, strength and speed may be developed. The purpose of the study was to examine the effects of circuit training program on the aerobic capacity, speed and explosive strength of school children.

Methodology

For the purpose of study a total of 40 school going boys having age ranged between 16 ± 2 years were selected. Random sampling method was used for the selection of participants. All the participants were physically fit and voluntarily consented take part in the training program. Parent consent and medical fitness was obtained before the initiation of the training program.

Experimental Design

Experimental design refers to the system of formulating the procedure of selection, methods of testing, administrating the training etc. it is the designed framework of the whole study which helps in the avoiding the threats on the conclusions of the study. The design used in the study is pretest and posttest design. The manifestation of the experimental design is as follows:

O TREATMENT (S1-S20) O
O CONTROL (S1-S20) O
O = OBSERVATIONS
S = SUBJECTS

The design depicts that the pre - test for both the groups will be done before the initiation of the experimental protocol begins. After the cessation of treatment, the post- test data was recorded for all the selected dependent variables.

The dependent variables selected for the study were:

1. Vital capacity – Spirometer
2. Speed – 50m sprint
3. Explosive strength – vertical jump

The independent variable was circuit training. There were 9 exercises in the circuit training program. The exercises were selected in such a way that 3 exercises could be attributed to the development of 3 variables each. For aerobic endurance shuttle run, leg splitting and skipping was selected. For speed, 30 m sprint, on the spot high knee running action and stair exercises were selected. For explosive strength, squat jumps, hops, and vertical jumps were selected. The exercises were performed for 30 seconds with a recovery of 40 seconds after each. Two repetitions of the exercises were performed after rest of 5 minutes between repetitions.

The training was imparted for 12 weeks for 4 days a week. The data was collected before and after the training program.

Statistical technique

The data was analyzed with the help of SPSS 20. Descriptive statistics i.e. mean and standard deviation was used to describe the nature of data. The significance of difference in the pre and posttest mean values was tested using dependent t test. The posttest mean values of control and experimental groups were compared by using independent t test. To test the significance if difference of mean values of control and experimental groups after eliminating the effect of covariates, ANCOVA was used. The level of significance was set at 0.05.

Results

The statistical techniques which were employed for the data analysis are presented in the tables below.

Table 1: Descriptive Statistics for the data on Speed, Vertical Jump and Vital Capacity of Experimental and Control Group Children

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	E_Pre_Speed	6.5600	20	.28320	.06332
	E_Post_Speed	6.6853	20	.17365	.03883
Pair 2	E_Pre_VJ	42.2500	20	2.84466	.63609
	E_Post_VJ	44.1000	20	2.84513	.63619
Pair 3	E_Pre_VC	2816.000	20	307.9883	68.8683
	E_Post_VC	3028.500	20	332.9813	74.4568
Pair 4	C_Pre_Speed	6.5340	20	.28971	.06478
	C_Post_Speed	6.5215	20	.27314	.06107
Pair 5	C_Pre_VJ	42.1500	20	2.66112	.59505
	C_Post_VJ	42.0500	20	2.98196	.66679
Pair 6	C_Pre_VC	2921.000	20	285.2681	63.7878
	C_Post_VC	2898.000	20	337.2426	75.4097

The descriptive statistics of the data on Speed, Vertical Jump and Vital Capacity of Experimental and Control group is presented in the Table Number 1. The mean and SD of E_Pre_Speed, E_Post_Speed, E_Pre_VJ, E_Post_VJ, E_Pre_VC, E_Post_VC, C_Pre_Speed, C_Post_Speed, C_Pre_VJ, C_Post_VJ, C_Pre_VC and C_Post_VC were found to be 6.56 (0.28), 6.68 (0.17), 42.25 (2.84), 44.1 (2.84), 2816 (3.7.9), 3028 (332), 6.53 (0.28), 6.52 (0.27), 42.15 (2.66), 42.05 (2.98), 2921 (285), and 2898 (337.24) respectively.

Table 2: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	E_Pre_Speed & E_Post_Speed	20	.880	.000
Pair 2	E_Pre_VJ & E_Post_VJ	20	.745	.000
Pair 3	E_Pre_VC & E_Post_VC	20	.947	.000
Pair 4	C_Pre_Speed & C_Post_Speed	20	.893	.000
Pair 5	C_Pre_VJ & C_Post_VJ	20	.742	.000
Pair 6	C_Pre_VC & C_Post_VC	20	.665	.001

The correlation coefficients between the pre and post data on all the selected variables with their significance value is presented in table 2. It is clearly evident from the table that all the correlation coefficients are significant at 0.05 level of significance.

The researcher has employed dependent t-test to test whether improvement in the dependent variable has happened or not. The tests for the same have been presented below.

Table 3: Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	E_Pre_Speed - E_Post_Speed	-.1253	.15439	.0345	-.19760	-.05309	-3.631	19	.002
Pair 2	E_Pre_VJ - E_Post_VJ	-1.85	2.0332	.4546	-2.80160	-.89840	-4.069	19	.001
Pair 3	E_Pre_VC - E_Post_VC	-212.5	107.20	23.97	-262.6746	-162.3254	-8.864	19	.000
Pair 4	C_Pre_Speed - C_Post_Speed	.012	.13106	.0293	-.04884	.07384	.427	19	.675
Pair 5	C_Pre_VJ - C_Post_VJ	.100	2.0493	.4582	-.85914	1.05914	.218	19	.830
Pair 6	C_Pre_VC - C_Post_VC	23.00	259.23	57.96	-98.32415	144.32415	.397	19	.696

The dependent t-test has been employed to know the improvement status in all the variables after the training and it is evident from the table that the improvement has happened only in case of experimental group (pair 1, pair 2 and pair 3). It indicates that the training was effective and it has significantly contributed in the development of all the selected variables.

Table 4: Levene's Test of Equality of Error Variances[a]

Dependent Variable: Post Speed (m/s)			
F	df1	df2	Sig.
.214	1	38	.646

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pre Speed + Treatment

Table 4 shows the value of Levene's test of Equality of Error Variances. The F-Value for the same has come insignificant as the Sig. Value is more than 0.05. The insignificance of the F-Value shows that the error variances of data were equal, which is one of the assumption and need to be fulfilled before employing the ANCOVA.

Table 5: Analyis of Covariance on The Data of Speed

Dependent Variable: Post Speed (m/s)					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Pre_Speed	1.505	1	1.505	114.622	.000
Treatment	.210	1	.210	16.030	.000
Error	.486	37	.013		
Total	1746.499	40			
Corrected Total	2.259	39			
a. R Squared = .785 (Adjusted R Squared = .773)					

Table 5 shows the analysis of covariance for the data on speed of children. The pre data on speed of children was found to be significantly different for both the groups which clearly shows that the decision of applying ANCOVA was correct. The F-Value for the treatment was also found to be significant which shows that the improvement in Speed of the children after the circuit training was significant.

Table 6: Levene's Test of Equality of Error Variances[a]

Dependent Variable: Post Vertical Jump (cm)			
F	df1	df2	Sig.
.171	1	38	.682

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pre_VJ + Treatment

Table 6 shows the value of Levene's test of Equality of Error Variances. The F-Value for the same has come insignificant as the Sig. Value is more than 0.05. The insignificance of the F-Value shows that the error variances of data were equal, which is one of the assumption and need to be fulfilled before employing the ANCOVA.

Table 7: Analyis of Covariance on the Data of Vertical Jump

Dependent Variable: Post Vertical Jump (cm)					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Pre_VJ	177.712	1	177.712	45.335	.000
Treatment	38.854	1	38.854	9.912	.003
Error	145.038	37	3.920		
Total	74583.000	40			
Corrected Total	364.775	39			

a. R Squared = .602 (Adjusted R Squared = .581)

Table 7 shows the analysis of covariance for the data on vertical jump of children. The pre data on vertical jump of children was found to be significantly different for both the groups. The F-Value for the treatment was also found to be significant which shows that the improvement in Vertical Jump of the children after the circuit training was significant.

Table 8: Levene's Test of Equality of Error Variances[a]

Dependent Variable: Post Vital Capacity (cm)			
F	df1	df2	Sig.
.405	1	38	.528

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pre_VC + Treatment

Table 8 shows the value of Levene's test of Equality of Error Variances. The F-Value for the same has come insignificant as the Sig. Value is more than 0.05. The insignificance of the F-Value shows that the error variances of data were equal, which is one of the assumption and need to be fulfilled before employing the ANCOVA.

Table 9: Analysis of Covariance on the Data of Vital Capacity

Dependent Variable: Post Vital Capacity (cm)					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Pre_VC	2797157.671	1	2797157.671	70.385	.000
Treatment	496527.851	1	496527.851	12.494	.001
Error	1470417.329	37	39741.009		
Total	355671900.000	40			
Corrected Total	4437877.500	39			
a. R Squared = .669 (Adjusted R Squared = .651)					

Table 9 shows the analysis of covariance for the data on vital capacity of children. The pre data on vital capacity of children was found to be significantly different for both the groups. The F-Value for the treatment was also found to be significant which shows that the improvement in Vital Capacity of the children after the circuit training was significant.

Discussion of the findings

The results of the study revealed that the circuit training program has significant effect on the aerobic endurance, speed and explosive strength performance of the participants. The results of the study indicated the similar effects could be replicated on school children also in manner it helps to increase the performance in adult athletes.

The significant improvement in the performance of vital capacity could be attributed to the effects of training. The strength in the muscles of pulmonary area may also be a contributing factor.

The combination of strength and endurance training may be resulted in the energy systems responsible for the development of speed by developing anaerobic energy systems. The explosive strength was also found to significantly improve due to the circuit training program. The development of proprioceptive system in muscles may have led to the increase in vertical jump performance

Conclusion

Based on the results of the study, the researcher wants to conclude that the circuit training is very helpful in improving the physical components like aerobic capacity, speed and explosive strength performance.

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