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Effects of plyometric, floor aerobic exercise and circuit training on physiological and haematological variables of volleyball players

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Abstract
The purpose of the study was to find out the effect of Plyometric, Floor Aerobic exercise and Circuit Training on Physiological and Haematological Variables of Volleyball Players. In order to achieve these objectives a sample of 40 volleyball players with (age 15-17 years) were selected from Vidyamangal Residential School, Subjects who agreed to participate in the experiment and met the inclusion criteria were selected and divided into Four groups with 40 volleyball children each by a randomized sampling method in the relevant experimental group A, B, C & control group-D. Experimental group A was exposed to structured Plyometric Training programme thrice a week, of 60 minutes, group B was exposed to Floor Aerobic exercise training programme thrice a week, group C was exposed to Circuit training programme thrice a week of 60 minutes and group D acted as a control group and did not get any structured training except daily routine programme of the school.
Evaluation of the selected variables among all the selected school students was completed before structured Plyometric training, then at the end of 6 weeks by using these said tools by adopting the standard procedures. Analysis of Covariance (ANCOVA) was applied the mean gains differences in various variables among school students of three experimental groups and control group and in case of significant differences Scheffe"s Post hoc test was followed to distinguish the degree and direction of adjusted means differences. The level of significance was set at 0.05 to test all hypotheses.

Keywords: Plyometric, floor aerobic exercise & circuit training, physiological variables, haematological variables, resting heart rate, breath holding capacity, vital capacity

Introduction
The word ‘training’ has remained an undivided part of human language from ancient times, which indicates a process of preparing oneself for any action or work. The process continues for days, months, or years. The term ‘training’ is more used in the field of sports and games. Coaches and sport scientists have differences in opinions of true meaning of training. Many experts, who are connected to medical field and understand sport training, consider training as the form of physical exercises, e.g. strength training, interval training, physical exercise training and tricked training. There is no guarantee of improvement in performance by regular practice of training. Moreover, other factors such as sports tools, physical vision, compensative instrument, tools of performance evaluation, projection, psychological instruments etc should be taken into consideration to attain better results.
Circuit training is very important for development of elements necessary for muscular fitness. Trainee has to do 8 to 12 exercises in this circuit training. The cycles for each type of exercise are also fixed. The sequence of exercises is also fixed. The resting time after finishing one exercise is also fixed. After completing the first exercise, 8 to 12 exercises are to be taken in sequence of second, third and next without stopping for a while. In this way, one cycle of circuit training is completed. Generally, three to five cycles are planned according to need of the players in the circuit training. After the player had finished the first cycle, the rest is given according to training weight age. Weight lifting exercises, other obstructive exercises, calisthenics, race, swimming or stretching exercises etc are included in the circuit training.
To form the structure of the circuit training, the coach measures characteristics of physical fitness of layers by giving a physical fitness test and decides which competencies they lack.

Then, the coach constructs the training programme for development of lacking competencies. For example, if the coach sees less strength of shoulder muscles, he will include the exercise 3 helpful to increase the strength of shoulder muscles in the circuit training. If the coach finds less speed, one or two exercises for increasing speed will be selected. In the same way, if developing the muscles of thigh or abdomen, some exercises for development of muscles of thigh or abdomen can be selected. Thus, one or two exercises for muscular power, flexibility, endurance etc are to be included in the circuit training and the structure of the training programme is prepared. Selections of exercises, exercise cycles, duration of training, density of exercise etc are to be determined while preparing structure for the circuit training.

Heart pounding cardio, this athletically challenging class leaves nobody untouched. We train on and off the platform to deliver an intense thorough workout. Bring your horsepower, exercises that are safe and effective in a group setting, with added posture correction exercises specific for each individual. This class consists of high intensity cardio & strength training in a safe, personalized environment.

Like most people, we've heard that physical activity, including exercise, is good for health. It's time to push yourself a little harder, take up a new activity, or find new ways to add exercise to your daily life. In earlier times, the nature of living provided enough physical activity to maintain high levels of physical fitness. Regular physical activity by children and adolescents increases physical fitness, reduces body fat, improves bone health, and reduces symptoms of anxiety and depression. Most research has focused on the physical health benefits of participating in physical activity, with little research on the mental and social health aspects.

Research Methodology & Procedure

Keeping the significance of plyometric training, floor aerobic exercise and circuit training in mind for the development of children with School students, the researcher therefore, planned to evaluate the effects of Plyometric, floor aerobic exercise and Circuit Training on Physiological and Haematological Variables of Volleyball Players. The objectives of the study were; to evaluate the effects of Plyometric Floor Aerobic exercise and Circuit Training on Physiological and Haematological Variables of Volleyball Players.

In order to achieve these objectives a sample of 40 students with (age 15-17 years) were selected from Vidyamangal Residential School, Subjects who agreed to participate in the experiment and met the inclusion criteria were selected and divided into four groups with 10 children each by a randomized sampling method in the relevant experimental group A, B, C & control group-D. Experimental group A was exposed to structured plyometric training programme thrice a week, of 60 minutes, group B was exposed to floor aerobic exercise training programme thrice a week, group C was exposed to circuit training programme thrice a week of 60 minutes and group D acted as a control group and did not get any structured training except daily routine programme of the school.

Evaluation of the selected variables among all the selected school students was completed before structured training, then at the end of 6 weeks by using these said tools by adopting the standard procedures. Analysis of Covariance (ANCOVA) was applied the mean gains differences in various variables among school students of two experimental groups and control group and in case of significant differences Scheffe"s Post hoc test was followed to distinguish the degree and direction of adjusted means differences. The level of significance was set at 0.05 to test all hypotheses.

Analysis of data results and Discussion

Table 1: Analysis of Co Variance on Resting Heart Rate of Experimental and Control Groups

Test	Group				ANCOVA Table			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	77.000	81.400	74.800	77.900	226.075	3	75.358	1.501
					1806.900	36	50.192	
Post-Test Mean	75.300	80.200	74.000	78.900	257.000	3	85.667	1.568
					1966.600	36	54.628	
Adjusted Mean	76.088	76.512	77.026	78.773	41.683	3	13.894	5.026*
					96.761	35	2.765	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of Resting Heart Rate test performance (Plyometric Training group = 77.000, Floor Aerobic Exercise = 81.400, Circuit training group = 74.800, Control group = 77.900) of pre-test was found 1.501, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 75.300, Floor Aerobic Exercise = 80.200, Circuit training group = 74.000, Control group = 78.900) of post-test was found 1.568, which was found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 76.088, Floor Aerobic Exercise = 76.512, Circuit training group = 77.026, Control group = 78.773) was found 5.026, which was found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was found significant. Means effect of experimental treatment was found in experimental group in compared with the control group.

Table 2: Paired Mean Difference of Experimental and Control Groups on Resting Heart Rate

Adjusted Post Test Means				Mean Difference	Critical Difference
Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group		
76.088	76.512			0.424	1.509
76.088		77.026		0.938	
76.088			78.773	2.684*	
	76.512	77.026		0.514	
	76.512		78.773	2.260*	
		77.026	78.773	1.746*	
76.088	76.512			0.424	
76.088		77.026		0.938	

*Significant difference at 0.05 level of confidence

The table '2' clearly displays that the paired mean significant discord on Resting Heart Rate among experimental and control groups. And the variation in Resting Heart Rate among the experimental and control groups were statistically difference significantly between the paired means of Plyometric Training and control groups, Floor Aerobic Exercise Training and control groups, Circuit Training and control groups. However there was no significant difference found between the paired means of Plyometric Training group and Floor Aerobic Exercise Training group on Resting Heart Rate. Post test mean values of Resting Heart Rate the Floor Aerobic Exercise Training group had excellent improvement than the Plyometric Training group. Plyometric Training group and Circuit Training group Post test mean values of Resting Heart Rate the Circuit Training group had excellent improvement than the Plyometric Training group.

Table 3: Analysis of Co Variance on Breath Holding Capacity of Experimental and Control Groups

Test	Group				ANCOVA Table			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	30.200	30.400	28.600	28.700	27.475	3	9.158	0.683
					482.500	36	13.403	
Post-Test Mean	35.400	39.200	35.800	31.700	282.275	3	94.092	8.308*
					407.700	36	11.325	
Adjusted Mean	35.240	38.995	35.993	31.871	251.167	3	83.722	7.629*
					384.104	35	10.974	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of Breath Holding Capacity test performance (Plyometric Training group = 30.200, Floor Aerobic Exercise = 30.400, Circuit training group = 28.600, Control group = 28.700) of pre-test was found 0.683, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 35.400, Floor Aerobic Exercise = 39.200, Circuit training group = 35.800, Control group = 31.700) of post-test was found 8.308, which was found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 35.240, Floor Aerobic Exercise = 38.995, Circuit training group = 35.993, Control group = 31.871) was found 7.629, which was found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was found significant. Means effect of experimental treatment was found in experimental group in compared with the control group.

Table 4: Paired Mean Difference of Experimental and Control Groups on Breath Holding Capacity

Adjusted Post Test Means				Mean Difference	Critical Difference
Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group		
35.240	38.995			-3.756	3.007
35.240		35.993		-0.754	
35.240			31.871	3.368*	
	38.995	35.993		3.002	
	38.995		31.871	7.124*	
		35.993	31.871	4.122*	
35.240	38.995			-3.756	
35.240		35.993		-0.754	

*Significant difference at 0.05 level of confidence

The table '4' clearly displays that the paired mean significant discord on Breath Holding Capacity among experimental and control groups. And the variation in Breath Holding Capacity among the experimental and control groups were statistically difference significantly between the paired means of Plyometric Training and control groups, Floor Aerobic Exercise Training and control groups, Circuit Training and control groups. However there was no significant difference found between the paired means of Plyometric Training group and Floor Aerobic Exercise Training group on Breath Holding Capacity. Post test mean values of Breath Holding Capacity the Floor Aerobic Exercise Training group had excellent improvement than the Plyometric Training group. Plyometric Training group and Circuit Training group Post test mean values of Breath Holding Capacity the Circuit Training group had excellent improvement than the Plyometric Training group.

Table 5: Analysis of Co Variance on Vital Capacity of Experimental and Control Groups

Test	Group				ANCOVA Table			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	299.500	300.500	349.500	312.500	16460.000	3	5486.667	2.299
					85930.000	36	2386.944	
Post-Test Mean	303.000	303.500	351.500	307.000	16662.500	3	5554.167	2.331
					85775.000	36	2382.639	
Adjusted Mean	318.888	318.395	317.737	309.979	530.974	3	176.991	5.952*
					1040.811	35	29.737	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of Vital Capacity test performance (Plyometric Training group = 299.500, Floor Aerobic Exercise = 300.500, Circuit training group = 349.500, Control group = 312.500) of pre-test was found 2.299, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 303.000, Floor Aerobic Exercise = 303.500, Circuit training group = 351.500, Control group = 307.000) of post-test was found 2.331, which was found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 318.888, Floor Aerobic Exercise = 318.395, Circuit training group = 317.737, Control group = 309.979) was found 5.952, which was found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was found significant. Means effect of experimental treatment was found in experimental group in compared with the control group.

Table 6: Paired Mean Difference of Experimental and Control Groups on Vital Capacity

Adjusted Post Test Means				Mean Difference	Critical Difference
Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group		
318.888	318.395			0.493	4.951
318.888		317.737		1.151	
318.888			309.979	8.909*	
	318.395	317.737		0.658	
	318.395		309.979	8.416*	
		317.737	309.979	7.758*	
318.888	318.395			0.493	
318.888		317.737		1.151	

*Significant difference at 0.05 level of confidence

The table '6' clearly displays that the paired mean significant discord on Vital Capacity among experimental and control groups. And the variation in Vital Capacity among the experimental and control groups were statistically difference significantly between the paired means of Plyometric Training and control groups, Floor Aerobic Exercise Training and control groups, Circuit Training and control groups. However there was no significant difference found between the paired means of Plyometric Training group and Floor Aerobic Exercise Training group on Vital Capacity. Post test mean values of Vital Capacity the Floor Aerobic Exercise Training group had excellent improvement than the Plyometric Training group. Plyometric Training group and Circuit Training group Post test mean values of Vital Capacity the Circuit Training group had excellent improvement than the Plyometric Training group.

Table 7: Analysis of Co Variance on Red Blood Cells of Experimental and Control Groups

Test	Group				ANCOVA Table			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	5.160	5.260	4.820	5.230	1.233	3	0.411	1.493
					9.905	36	0.275	
Post-Test Mean	4.850	5.140	5.100	5.040	0.495	3	0.165	0.644
					9.213	36	0.256	
Adjusted Mean	4.845	5.123	5.135	5.027	0.533	3	0.178	0.684
					9.079	35	0.259	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of Red Blood Cells test performance (Plyometric Training group = 5.160, Floor Aerobic Exercise = 5.260, Circuit training group = 4.820, Control group = 5.230) of pre-test F ratio was found 1.493, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 4.850, Floor Aerobic Exercise = 5.140, Circuit training group = 5.100, Control group = 5.040) of post-test F ratio was found 0.644, which was not found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 4.845, Floor Aerobic Exercise = 5.123, Circuit training group = 5.135, Control group = 5.027) was found 0.684, which was not found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was not found significant. Means effect of experimental treatment was not found in experimental group in compared with the control group. Therefore, the training provided does not prove to have significantly improved the performance of the subjects.

Table 8: Analysis of Co Variance on White Blood Cells of Experimental and Control Groups

Test	Group				ANCOVA TABLE			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	6142.000	6473.700	6925.000	6913.200	4287086.275	3	1429028.758	0.993
					51806177.700	36	1439060.492	
Post-Test Mean	6043.600	6704.900	6464.400	6901.400	4094081.675	3	1364693.892	1.140
					43087096.100	36	1196863.781	
Adjusted Mean	6196.220	6750.146	6363.557	6804.377	2584580.016	3	861526.672	0.801
					37658530.540	35	1075958.015	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of White Blood Cells test performance (Plyometric Training group = 6142.000, Floor Aerobic Exercise = 6473.700, Circuit training group = 6925.000, Control group = 6913.200) of pre-test F ratio was found 0.993, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 6043.600, Floor Aerobic Exercise = 6704.900, Circuit training group = 6464.400, Control group = 6901.400) of post-test F ratio was found 1.140, which was not found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 6196.220, Floor Aerobic Exercise = 6750.146, Circuit training group = 6363.557, Control group = 6804.377) was found 0.801, which was not found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was not found significant. Means effect of experimental treatment was not found in experimental group in compared with the control group. Therefore, the training provided does not prove to have significantly improved the performance of the subjects.

Table 9: Analysis of Co Variance on Hemoglobin of Experimental and Control Groups

Test	Group				Ancova Table			
	Plyometric Training	Floor aerobic exercise Training	Circuit Training	Control Group	Sum of Square	DF	Mean Square	'F' ratio
Pre-Test Mean	13.080	13.780	13.440	13.670	2.871	3	0.957	0.694
					49.637	36	1.379	
Post-Test Mean	13.120	12.360	13.140	13.020	4.116	3	1.372	0.841
					58.720	36	1.631	
Adjusted Mean	13.194	12.308	13.149	12.988	4.903	3	1.634	1.002
					57.115	35	1.632	

*Significant level at 0.05 F = 0.05 (3, 27) = 2.866 & (3, 26) = 2.874

'F' ratio of mean of Hemoglobin test performance (Plyometric Training group = 13.080, Floor Aerobic Exercise = 13.780, Circuit training group = 13.440, Control group = 13.670) of pre-test F ratio was found 0.694, which was not significant at (2.866) 0.05 level according to tabular value. 'F' ratio of mean (Plyometric Training group = 13.120, Floor Aerobic Exercise = 12.360, Circuit training group = 13.140, Control group = 0.841) of post-test F ratio was found 0.841, which was not found significant at (2.866) 0.05 level according to tabular value, so significant improvement was proved in performance of subjects by training provided to them. Moreover, 'F' ratio of adjusted mean (Plyometric Training group = 13.194, Floor Aerobic Exercise = 12.308, Circuit training group = 13.149, Control group = 12.988) was found 1.002, which was not found significant at (2.874) 0.05 level according to tabular value. Difference between adjusted mean of both groups by 'F' ratio was not found significant. Means effect of experimental treatment was not found in experimental group in compared with the control group. Therefore, the training provided does not prove to have significantly improved the performance of the subjects.

Conclusions

The following conclusions were drawn on the basis of above findings:

- Remarkable improvement was found in Resting Heart Rate of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- Remarkable improvement was found in Breath Holding Capacity of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- Remarkable improvement was found in Vital Capacity of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- Remarkable improvement was not found in Red Blood Cells of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- Remarkable improvement was not found in White Blood Cells of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- Remarkable improvement was not found in Hemoglobin of selected subjects by six (6) week systematic Plyometric, Floor Aerobic Exercise and Circuit training.
- The six-week training program showed an improvement in the Physiological variables and of the Volleyball Players.
- The six-week training program showed not improvement in the Haematological variables and of the Volleyball Players.
- That the Six-week Plyometric, Floor Aerobic Exercise and Circuit training of three days a week (1 hour session) proved to be effective for the development of Physiological and Haematological Variables of Volleyball Players.

Recommendations

On the basis of the findings and conclusions of the study, the following recommendations have been drawn:

- Such research studies can be conducted in various forms at international, national, state or district level players.
- This type of research study can be done by taking large samples.
- Such study can be conducted in selecting players of different levels as well as different sports.
- Such study can be undertaken by selecting male students of different schools.
- Such research studies can be conducted to training programs of different periods.
- Such research study can be carried out by selecting subjects of different ages.
- Such study can be conducted by keeping in view the different geographical area of India.
- Such study can be conducted on Female athletes.
- Such study can be conducted by various trainings (interval training, fatleg training).
- Such research studies can be conducted in other sports and sports along with the game of volleyball

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