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The Effect Of Selected Progressive Circuit Training On Blood Lactic Acid As A Determinate Of Recovery Process Among Individual And Team Sports

Titir Hore[1*], Anjani Yadav[2], Debraj Bhattacharya[3], Nutan[4], Sushma Ghildyal[5]

[1,2,4]Research Scholar, Department of Physical Education (Faculty of Arts), Banaras Hindu University,India(titirhore@gmail.com),(anjaniyadavbhu21@gmail.com),
[3]Assistant Professor, School of Sports Studies, TransStadia University, Ahmedabad, India (debrajb7770@gmail.com)
[5]Professor Department of Physical education (Faculty of Arts), Banaras Hindu University, India (sushmaghildyal@yahoo.com)

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Abstract
The study was conducted to find out the effect of progressive circuit training on blood lactic acid as a determinate of recovery process among individual and team sports.
Objective: To find out the effect of progressive circuit training on blood lactic acid as a determinate of recovery process among individual and team sports.
Methodology: The subjects were assembled at the LNIPENERC Guwahati (Assam, India) track and field ground and briefed about Four weeks training plan.8-10 exercises were given in one set of circuit. This training was given threealternative days in a week.
Statistics: In order to examine the hypothesis of the study, descriptive statistics (M & S.D.) and Analysis of Co-variance (ANCOVA) was employed as a statistical measure for the present study by using SPSS- 2.0
Conclusion: In the present research study, it was found that there was a statistically significant difference between individual and team sports.

KEYWORDS: Circuit Training, Blood Lactate Acid, Recovery, Team Game, Individual Sports

INTRODUCTION:

Rotating through a circuit of up to 10 exercises that target various muscle groups is known as circuit training. Instead than referring to a particular activity, circuit training describes the layout of a workout plan. [1]Circuit training, a type of body conditioning that combines high-intensity aerobic exercise with exercises done in a circuit pattern, is comparable to high-intensity interval training. It aims to increase physical endurance and strength. The program's set exercises are completed in a "circuit" as a whole. One starts the initial exercise over again for the subsequent circuit once one cycle is finished. [2] In circuit training, the rest intervals between exercises are typically brief, with quick transitions to the following activity. The software was created. Subject performed each set of exercises for a specific number of repetitions, or times, throughout circuit training. Then, with little to no pause in between, it would be switch to a different activity for the same number of repetitions

or duration. An entire circuit training session can typically be finished in approximately 30-45 minutes because we travel around the circuit of exercises rather rapidly.[1] Circuit training can be modified in a variety of ways depending on specific preferences for exercise types, intensity, and length. It is a flexible and highly customizable form of exercise. Circuit training has certain health advantages in addition to being adaptable, which can make exercising more interesting and pleasant. It might aid in gaining strength and weight loss. It could make your heart healthier. [1] According to research from Baylor University and The Cooper Institute, circuit training is the most time-effective method for boosting muscular endurance and cardiovascular fitness. Studies demonstrate that compared to other forms of exercise or nutrition, circuit training helps women accomplish their goals and keep them longer. [3] The investigation clearly demonstrates that performance of this circuit of exercises at this level of intensity resulted in oxygen consumption values (39% to51.5% of VO2max) that meet established guidelines of the American College of Sports Medicine (ACSM) for the recommended intensity (40% to 85% of VO2maxR) of exercise for developing and maintaining cardio-respiratory fitness. This may be the most significant finding of this study from a health perspective. As a result, this circuit helps to satisfy the recommendations for physical activity in the recently released Dietary Guidelines for Americans 2005 as well as the ACSM's cardiovascular guidelines.[4] Reduced station times have the advantage of motivating participants to use heavier weights, which allows them to attain overload with fewer repetitions—typically between 25 and 50, depending on their training objectives.[5] Session of circuit weight training (CWT) last only 25 to 30 minutes and can enhance strength, body composition, and cardio-respiratory endurance. CWT enhanced aerobic capacity by roughly5%, according to the studies examined in this article, whereas other aerobic training programs raised it by 15% to 25%. Fat mass reduced by 0.8% to 2.9% while lean body mass rose by 1 to 3.2 kg. Strength increased from 32% to 7%. CWT has energy costs comparable to jogging at 5 mph.[6] The authors come to the conclusion that increases in strengthand Vo2 max depend on the amount of work done rather than the tools employed. CWT can aid in maintaining fitness even when it does not significantly increase aerobic fitness. A by product of glycolysis or when our body converts glucose into energy, is lactic acid, which is created by your body. The subsequent conversion of lactic acid to lactate results in the release of hydrogen ions into the circulation. [7]` Red blood cells and muscle cells both produce lactic acid. It develops when the body converts carbs to glucose under specific circumstances while exercising. The body cannot provide the amount of oxygen that muscles needduring high-intensity activity, which results in anaerobic respiration and lactic acid buildup. The degree of one's fitness determines when lactic acid starts to form. When lactic acid builds up, the body is able to eliminate it, but when levels start to raise quickly, the body might not be able to keep up. The muscles become fatigued and may not be able to contract as forcefully when this excess acid develops. During exercise, some people may experience a burning feeling in their muscles.[8] Red blood cells and muscle cells both produce lactic acid. It creates what medical condition known as lactic acidosis is defined by the accumulation of lactate (particularly L-lactate) in the body and the development of an abnormally low pH in the bloodstream. It is atype of metabolic acidosis where too much acid builds up as a result of an issue with the body's oxidative metabolism. [9] Usually, an underlying acute or chronic medical problem, medication, or poisoning cause's lactic acidosis. These underlying causes are often responsible for the symptoms, which also include generalized weakness, nausea, vomiting, andKussmaul breathing (labored, deep breathing).[10] When the body needs glucose, it breaks down carbs. When exercising hard, there might not be enough oxygen available to finish the process, hence lactate is produced. This lactate can be converted by our body

into energy without the use of oxygen. But this lactic acid, also known as lactate, can accumulate in our system more quickly than it can be burn it off. The time when lactic acid production begins.[11]

METHODOLOGY:

Selection of Subject: For the purpose of the study, a total of fifteen (n=15) undergraduate male [Five (n=5)] students from individual sports like Track and Field specialization and five (n=5) students from team game Hockey specialization students of Lakshmibai National Institute of Physical Education, NERC Guwahati, Assam, India, were taken as subject for analysis the effect of progressive circuit training on blood lactic acid.

The subjects were divided into three groups for the study (see Table No 1). Experimental Group 1 consisted of 5 students specializing in individual sports like Track and Field, who were treated with progressive circuit training over a duration of 4 weeks. Experimental Group 2 included 5 students specializing in team games like Hockey. The Control Group 3 comprised 5 students (2 from Track and Field and 3 from Hockey) who did not receive any treatment.

Table No: 1Subject Characteristics

Groups	No of Students	Sports Specialization
Experimental group1	N=5	Individual Sports[Track & Field]
Experimental group 2	N=5	Team Game [Hockey]
Control Group 3	N=5	Combine [2 from track field and 3 from hockey]

Selection of Variables: The researcher selected specific variables for data collection in the present study. The independent variable was Circuit Training, while the dependent variable was Blood Lactate, which was measured to determine the recovery process.

Circuit training Schedule: The circuit training was given to the experimental group1 (track & field specialization) and experimental group 2 (hockey) specialization, every alternative days (3 days) in a week. In one set of circuit there were 8 to 10 exercises like push us, sit ups, squat thrust, step up, box jumps etc. Duration of each exercise was 30 to 40 sec. The recovery was given about 1 to 2 min after finishing one set of circuit.

Table No: 2 Schedule of Circuit training

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	X	*	#	*	#	*	#
2	X	*	#	*	#	*	#
3	X	*	#	*	#	*	#
4	X	*	#	*	#	*	#

Table 2 outlines the schedule of circuit training over a four-week period. The schedule indicates that Sundays (marked as X) had no activity. On Mondays, Wednesdays, and Fridays, marked with (*), Track and Field specialization students participated in circuit training. On Tuesdays, Thursdays, and Saturdays, marked with (#), Hockey specialization students engaged in their respective circuit training. Each training session was preceded by a 10-minute dynamic warm-up and followed by a 5-minute cool-down. This regimen was consistently followed throughout the four-week training period.

Table No 3: Type of Exercises Weakly Training Plan

First week Exercises	Duration	Second week Exercises	Duration	Third week Exercises	Duration	Fourth week Exercise	Duration
Push ups	30 sec	Bench press	40 sec	Finger pushup	40sec	Pull ups	45 sec
Abdominal crunches	30 sec	V sit-ups	40 sec	Sit-ups with bend leg	40sec	Twist sit up	45 sec
Step ups	30 sec	Spot jumps	40 sec	Step ups (10kg)	40sec	Step up	45 sec
Squat	30 sec	Step up	40 sec	Squat with 10kg	40sec	Squat	45 sec
Planks	30 sec	Front press (10 kg)	40 sec	Burpee	40sec	Lunging	45 sec
Lunging	30 sec	Squat jumps	40 sec	Spot jumps	40sec	Burpee	45 sec
Burpee jumps	30 sec	Burpee	40 sec	Squat thrust	40sec	Squat thrust	45 sec
Squat thrust	30 sec	Box jumps	40 sec	Lunging(10kg)	40sec	Triceps curl	45 sec
Box jumps	30 sec	Squat thrust	40 sec	High knee (10)kg	40sec	Spot jumps	45 sec
Triceps Dip on chair	30 sec	Lunging	40 sec	Triceps Curls	40sec	Biceps curl	45 sec

*Recovery 30 second (sec) for the entire gap between exercises

Experimental Procedure: The data of the subjects have been collected under the strict norms of medical. As blood sample of each subjects have been collected for the study. The following procedure where implemented during the data collection.

- The subjects were asked to wash off their middle finger with clean water and cotton.
- Secondly the researcher inserted a brand new needle used in medical to take out subject's blood sample.
- The blood sample is carefully placed on lactate strip which is now attached with lactate analyzer.
- The analyzer as soon as the blood sample is placed in lactate strip soaks it up and gives the reading within 10 sec.
- The researcher finally writes the reading in her/his notepad for analyze.

Similar process has been done to collect all the data i.e. pre and post.

Statistical Technique: In order to examine the hypothesis of the study, descriptive statistics such as mean, standard deviation and comparative statistics such as ANCOVA has been employed as a statistical measure for the present study by using S.P.S.S Version 2.0.

RESULT AND ANALYSIS OF DATA:

The analysis of the data of 15 players (5 Hockey players, 5 Track and field athletes and control group) has been described in this chapter. The data were analysed using covariance (ANCOVA) in order to determine the difference, if any. After the analysis of covariance to find out the paired

mean difference Post hoc LSD test applied between the mean of collected data. To test hypothesis the level of significance was set at 0.05.

Various descriptive measures like mean, standard deviation for selected variable calculated and presented in table 1.

Table No: 4 Descriptive analysis of mean and standard deviation of lactate of individual and team

Groups	No of Students	Mean	S.D.
Experimental group1[Track & Field]	5	1.940	0.387
Experimental group 2 [Hockey]	5	1.440	0.364
Control Group 3	5	3.480	0.993
Total	**15**		

Table No 4 indicated descriptive statistics of lactic acid of Experimental Group 1 (Track & Field): This group consists of 5 students who participated in Track & Field activities. The mean lactate level for this group is 1.940 with a standard deviation of 0.387, indicating relatively consistent lactate levels among these students. Experimental Group 2 (Hockey): This group also consists of 5 students, but they participated in Hockey. The mean lactate level for this group is 1.440 with a standard deviation of 0.364, which is lower than that of the Track & Field group, suggesting a difference in lactate levels based on the type of sport. Control Group 3: This group of 5 students did not participate in any specific sports activity. The mean lactate level for the control group is significantly higher at 3.480 with a standard deviation of 0.993, indicating greater variability in lactate levels among these students compared to the experimental groups. Additionally Figure 1 highlighted graphical representation of experimental group and control group.

Fig .1 Graphical represent of mean and SD of lactic acid among Experimental group and Control group

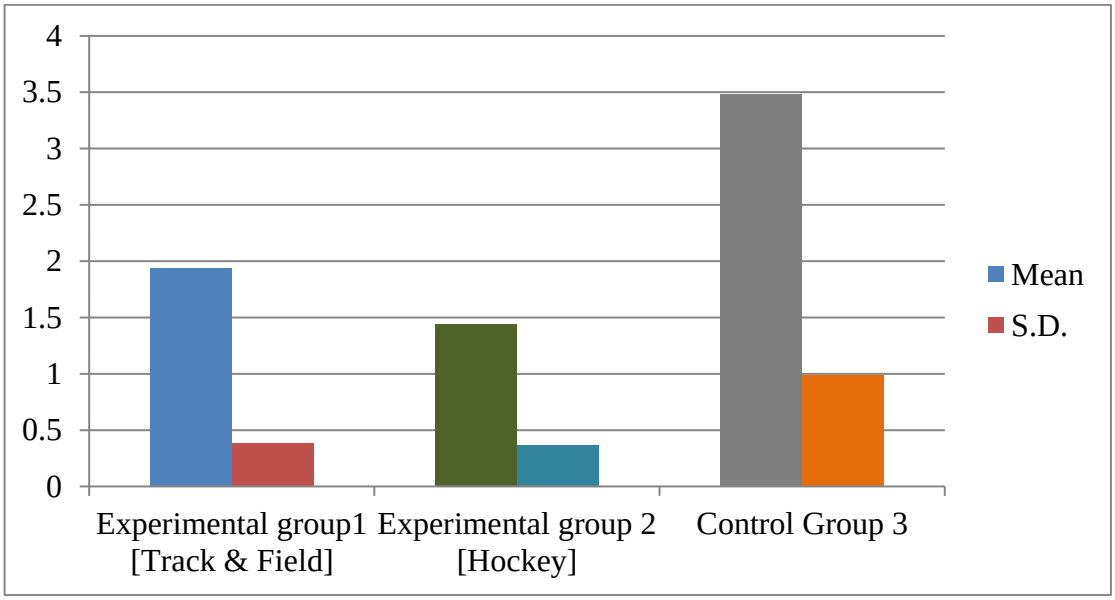

Table No: 5

Source of variance	df	SS	MSS	F Ratio
Treatment	2	10.85	5.42	14.62
Error	11	4.08	0.37	
Total	15			

*Significant, F0.05 (2,11) =3.98

From Table 5 it can be seen that the adjusted F-Value for Treatment is 14.62 which is significant at 0.05 level with df = 2/11. It indicates that the adjusted mean scores of Blood lactate of Players belonging to Track & Field, Hockey and Control Groups differ significantly. So there was a significant effect of Training on Blood lactate capacity of Players. Thus the null hypothesis that there is no significant improvement of recovery pattern of the 4 week of circuit training is rejected. In order to know the 4 week circuit training significantly effects to which particular group, the data were further analyzed with the help of t-Test and the results are given in Table 3

Table No 6 Tests of between subject effects

Source	Type 1 Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	12.29	3	4.09	11.04	0.001
Intercept	5.23	1	5.23	14.10	0.003
Groups	10.85	2	5.42	**14.62**	0.001
Predate	0.99	1	0.99	2.66	0.131
Error	4.08	11	0.37		
Total	94.81	15			
Corrected Total	16.37	14			

Table No. 6 presents the results of the tests of between-subject effects, which examine the impact of different factors (sources of variation) on the dependent variable. The table includes information on the type I sum of squares, degrees of freedom (df), mean square, F-ratio (F), and significance value (Sig) for each source. Corrected Model: This source represents the combined effect of all factors included in the model. The corrected model has a type I sum of squares of 12.29, with 3 degrees of freedom, resulting in a mean square of 4.09. The F-ratio for the corrected model is 11.04, with a significance value of 0.001. This indicates that the overall model is statistically significant and explains a significant portion of the variance in the dependent variable. Intercept: The intercept term has a type I sum of squares of 5.23 with 1 degree of freedom, leading to a mean square of 5.23. The F-ratio for the intercept is 14.10, with a significance value of 0.003. This suggests that the intercept is also statistically significant, indicating a baseline effect on the dependent variable. Groups: This factor represents the different experimental and control groups. The groups have a type I sum of squares of 10.85 with 2 degrees of freedom, resulting in a mean square of 5.42. The F-ratio for the groups is 14.62, with a significance value of 0.001. This indicates that there are significant differences between the groups in terms of the dependent variable. Predate: This factor has a type I sum of squares of 0.99 with 1 degree of freedom, resulting in a mean square of 0.99. The F-ratio for predate is 2.66, with a significance value of 0.131. This indicates that the predate factor is not statistically significant, suggesting that this

variable does not have a significant impact on the dependent variable. Error: The error term, representing unexplained variance, has a sum of squares of 4.08 with 11 degrees of freedom, leading to a mean square of 0.37. Total: The total sum of squares for the model is 94.81 with 15 total degrees of freedom. Corrected Total: The corrected total sum of squares is 16.37 with 14 degrees of freedom, which includes both the explained variance (corrected model) and the unexplained variance (error).

Table – 7 Group-wise comparisons of adjusted mean scores of Blood lactates of Players by considering Pre-training score as covariate

Group	Adj. Mean	Std. Error
Track & Field	1.99	0.27
Hockey	1.42	0.27
Control group	3.44	0.27

Table 7 indicates that the adjusted mean scores blood lactate level of player belonging to Hockey and control group differ significantly. Further the adjusted mean score of blood lactate level of Hockey is 1.42 which is significantly higher than that of control group whose adjusted mean score is 3.44. It may, therefore be said that 4 week of circuit training was found to be significantly superior to traditional training in terms recovery pattern of the players. It indicates that the adjusted mean scores blood lactate level of player belonging to Track & Field and control group differ significantly. Further the adjusted mean score of blood lactate level of Track & Field is 1.99 which is significantly higher than that of control group whose adjusted mean score is 3.44. It may, therefore be said that 4 week of circuit training was found to be significantly superior to traditional training in terms recovery pattern of the players. Weather the 4 week circuit training is effective for improving recovery of Track & field and Hockey group but Hockey group has improve significantly higher than Track & Field group.

DISCUSSION:

The analysis revealed significant differences in blood lactate levels between the experimental groups (Track & Field, Hockey) and the control group, as well as between the experimental groups themselves. The data indicate that both experimental groups showed significant improvement in blood lactate levels compared to the control group, demonstrating the efficacy of the 4-week circuit training program. Notably, the Hockey group exhibited a more pronounced improvement than the Track & Field group. The results clearly show that the 4-week circuit training program significantly improved the recovery patterns of players in both experimental groups. The mean lactate levels of the Track & Field group decreased to 1.940, and the Hockey group decreased to 1.440, compared to the control group's mean of 3.480. The lower lactate levels in the experimental groups suggest that circuit training effectively enhances lactate clearance and improves recovery. The adjusted mean scores of blood lactate levels further confirm the significant differences between the groups. The adjusted mean for the Hockey group was 1.42, while the Track & Field group had an adjusted mean of 1.99. The control group's adjusted mean was 3.44. These results indicate that the Hockey group benefited more from the circuit training than the Track & Field group. This superior improvement in the Hockey group could be attributed to the nature of team sports, which often involve varied intensity and intermittent bouts of high-intensity activity, possibly making the circuit training more effective for these athletes. The control group did not show significant improvement in blood lactate levels, with a mean of 3.480 and a higher

standard deviation of 0.993, indicating greater variability and less effective recovery. This highlights the importance of structured physical training programs in improving physiological parameters like blood lactate levels, essential for effective recovery and performance. The findings align with previous research by Wasserman (1994), who concluded that lactate is a critical metabolic parameter indicating muscle skill and athletic performance. The ability of muscles to perform at maximum capacity while maintaining balanced energy levels is reflected in the improved lactate clearance observed in the experimental groups. Furthermore, Kaya et al. (2013) demonstrated a significant relationship between applied load means, heart rate, and blood lactate levels, supporting the current study's findings. Their research revealed that increased training load correlates with improved heart rate and blood lactate levels, further validating the effectiveness of the 4-week circuit training program in enhancing recovery patterns and overall athletic performance.

CONCLUSION:

The discussion emphasizes the effectiveness of the 4-week circuit training program in significantly improving blood lactate levels and recovery patterns among individual and team sport athletes. The superior improvement observed in the Hockey group suggests that team sports athletes may benefit more from such training programs. The findings are consistent with existing literature, reinforcing the importance of structured training interventions in enhancing athletic performance and recovery.

Conflict of Interest:

The authors declare that there is no conflict of interests regarding the publication of paper.

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